Chapter 4
Species Assessment Methods and Impact Analyses

4.1 Introduction

This section describes the methods used to determine potential effects of the EWA Proposed Action on special-status fishery resources within the Action Area. Special-status fish species within the Action Area are comprised of those species that are Federally and state-listed species and species that are candidates for federal listing including:

- Winter-run Chinook salmon (*Oncorhynchus tshawytscha*);
- Spring-run Chinook salmon (*Oncorhynchus tshawytscha*);
- Steelhead (*Oncorhynchus mykiss*);
- Delta smelt (*Hypomesus transpacificus*);
- Sacramento splittail[1] (*Pogonichthys macrolepidotus*);
- Fall-run/late-fall-run Chinook salmon[2] (*Oncorhynchus tshawytscha*); and
- Green sturgeon[3] (*Acipenser medirostris*).

Evaluating potential effects on fishery resources within the Action Area requires an understanding of fish species' life histories and lifestage-specific environmental requirements. This information is provided for the special-status fish species listed above that occur (or potentially occur) within the Action Area in Section 9.1, Affected Environment/Existing Conditions of the EWA EIS/EIR. Ecological and status information on these species is provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP.

Fall-run/late-fall-run Chinook salmon, winter-run Chinook salmon, spring-run Chinook salmon, steelhead, delta smelt, Sacramento splittail, and green sturgeon are sensitive to changes in both river flow and water temperature throughout the year. An evaluation of effects on these special-status fish species is believed to reasonably encompass the range of potential effects upon other fish resources (hardhead, white

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[1] Under a Federal District Court ruling, the splittail rule has been remanded to USFWS. Splittail continue to be treated as a listed species, however no actions that may harm water users may be taken to protect splittail (DOI 2003).
[2] The Central Valley fall-run/late-fall-run Chinook salmon is identified as one Evolutionarily Significant Unit (ESU), and is a candidate species under the federal Endangered Species Act (ESA).
[3] NOAA Fisheries recently reviewed the petition for listing green sturgeon and determined that such listing currently is not warranted, although it is still considered a candidate species.

sturgeon, longfin smelt, Pacific lamprey, river lamprey, Kern brook lamprey, Sacramento perch, San Joaquin roach) that could occur with implementation of the Proposed Action relative to the basis of comparison. Furthermore, there is not sufficient information available regarding these species to develop rigorous effect indicators and evaluation criteria similar to those developed for the special-status species listed above. Therefore, because several of the life history requirements (e.g., spawning temperature ranges) for these species are similar to or less stringent than those for Chinook salmon, the life history and species criteria (water temperature and flow) used for Chinook salmon is thought to be more conservative and will apply to these species. Brief species-specific narratives supporting this assumption are provided in Section 9.1, Affected Environment/Existing Conditions of the EWA EIR/EIS.

The analysis of effects of a particular action on a biological resource can be composed of one or more types of effects. Direct and indirect effects, interrelated and interdependent effects, and cumulative effects are defined below.

Direct and Indirect Effects. Under FESA, direct effects are those that are caused by the proposed action and occur at the time of the action. According to the USFWS and NOAA Fisheries, indirect effects*"…are caused by or result from the proposed action, are later in time, and are reasonably certain to occur, e.g., predators may follow ORV tracks into piping plover nesting habitat and destroy nests; the people moving into the housing unit may bring cats that prey on the mice left in the adjacent habitat. Indirect effects may occur outside of the area directly affected by the action"* (USFWS and NOAA Fisheries 1998).

The USFWS CALFED BO states that indirect effects of the CALFED Program, including the EWA, include the conversion of upland habitats into agricultural or urban land uses, facilitated by the availability and use of CVP/SWP water supplies, and preclusion of restoration activities for levee reconstruction and maintenance activities (USFWS 2000). However, the USFWS CALFED BO also states *"The EWA works on a principle of 'no harm' to south of Delta deliveries, which means that the EWA essentially changes the* timing *of exports but does not change the overall magnitude or timing of deliveries"* (USFWS 2000). Since the EWA would not change the overall magnitude or timing of deliveries to the export service area, the EWA would not result in the conversion of upland habitats into developed areas. Further, the EWA would not be expected to result in additional levee reconstruction or maintenance activities than would occur under the basis of comparison. Therefore, it is not anticipated that the EWA would result in indirect effects.

Interrelated and Interdependent Effects. According to FESA, interrelated and interdependent actions are defined as follows:

> *Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An <u>interrelated</u> activity is an activity that is part of the proposed action and depends on the proposed*

action for its justification. An <u>*interdependent*</u> *activity is an activity that has no independent utility apart from the action under consultation.*[4]

According to the USFWS and NOAA Fisheries, interrelated actions are those that are part of the proposed action and depend on the proposed action for their justification - actions that would not occur "but for" the larger action of the action under consultation (proposed action) (USFWS and NOAA Fisheries 1998). Interdependent actions are those that have no significant utility apart from the action that is under consideration (USFWS and NOAA Fisheries 1998). The EWA is one of many programs established under the framework of CALFED. Further, other programs proposed separately under the CALFED Program would function independently of the EWA. However, all the programs proposed under the CALFED Program need to be implemented in order to achieve CALFED goals. The EWA Program is interrelated to the larger CALFED program, because it is part of the CALFED Program. The EWA has no independent utility apart from the larger CALFED program and is an interdependent component of the larger CALFED program. Therefore, the analysis of effects includes those resulting from other interrelated or interdependent CALFED programs, which are discussed in Section 1.4 of the EWA EIS/EIR.

The basis of comparison for this ASIP is the existing condition without the EWA Proposed Action (operating conditions of the CVP/SWP without the EWA). The No Action Alternative and Baseline Condition are termed the "basis of comparison," as referred to throughout the analysis of the EWA Proposed Action (the Flexible Purchase Alternative in the EWA EIS/EIR).

The USFWS and NOAA Fisheries have defined the different conclusions and determinations that can be reached through consultation with these agencies. These different conclusions are "*it is likely to adversely affect*," "*it is likely to jeopardize proposed species/adversely modify proposed critical habitat*," and "*it is not likely to adversely effect*" (USFWS and NOAA Fisheries 1998). "*It is likely to adversely affect*" is the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action, or indirect result of the interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. In the event the overall effect of the proposed action is beneficial to the listed species, but also is likely to cause some adverse effect, then the proposed action "*is likely to adversely affect*" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "*is likely to adversely affect*" determination should be made (USFWS and NOAA Fisheries 1998). "*It is likely to jeopardize proposed species/adversely modify proposed critical habitat*" is the appropriate conclusion when the action agency or USFWS and/or NOAA Fisheries identify situations where the proposed action is likely to jeopardize the proposed species or adversely modify critical habitat. If this conclusion is reached, conference is required (USFWS and NOAA Fisheries 1998). "*It is not likely to adversely affect*" is the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial (USFWS and NOAA Fisheries 1998).

[4] Source: Federal Endangered Species Act (FESA) (50 CFR Section 402.02).

The effect indicators selected to evaluate the resource topics represent the potential effect issues for the resource. The anticipated change that would occur is compared against the evaluation criteria to ascertain whether the EWA Proposed Action would result in a "*no effect*," "*may affect - not likely to adversely effect*," or "*may affect - likely to adversely effect*" determination. In most instances, where a potential adverse effect may occur, environmental protection measures to reduce environmental effects to "*not likely to adversely effect*" have been identified and incorporated (see Section 2.5, Conservation Measures, of the ASIP).

The following analyses provide an evaluation of how the Proposed Action would affect the fisheries resources listed above within each of the three regions included within the Action Area (Section 4.1.1, Upstream from the Delta Region, Section 4.1.2, Delta Region, and Section 4.1.3, Export Service Area). The analyses contained herein rely extensively upon the discussion of fish species' life histories and lifestage-specific environmental requirements, the identification of effect indicators and evaluation criteria, and the detailed species-, lifestage-, river system-, and Delta-specific analyses included within the EWA EIS/EIR. In order to reduce redundancy, the detailed analyses included in the EWA EIS/EIR for the Upstream of the Delta Region are summarized in this ASIP, with specific references provided to individual sections of the EWA EIS/EIR. The analyses of potential effects with implementation of the Proposed Action on special-status fish species within each of the three regions is followed by a summary of potential effects identified for each special-status species included in the ASIP.

4.1.1 Analysis of Potential Hydrologic Effects on Special-Status Fish Species Within the Upstream from the Delta Region

For this ASIP, consideration of the species identified above in the determination of potential effects ensures compliance with federal regulatory requirements under Section 7 of the FESA, state requirements under CESA, NCCPA requirements, and EFH requirements for Anadromous Fish Habitat and Species as described in Sections 1.2.4, 1.2.5, and 1.2.6. A separate analysis of the NCCPA fish group "anadromous fish species" is not included because it would be redundant with the species-specific analysis of fish that are in this group, which is provided below.

4.1.1.1 Environmental Setting

The regional setting for the fisheries resources located within the Upstream from the Delta Region includes the Sacramento, Feather, Yuba, American, Merced and San Joaquin Rivers and associated Project reservoirs, as well as several non-Project reservoirs. These areas may be influenced by implementation of the EWA Proposed Action.

Narratives describing basin-specific conditions (e.g., species composition, distribution, time of year when the species is present in the river, and current management objectives) for each of the major river basins that are being evaluated in this region of the Action Area are provided in Section 9.1.1, Upstream from the Delta

Region, of the EWA EIR/EIS. Life histories and lifestage-specific environmental requirements for several species may differ slightly among the water bodies. Any differences are noted in the discussions of the individual water bodies. If there are not any noted differences, the species life history and environmental requirements are assumed to be identical to the general discussions in Section 9.1, Affected Environment/Existing Conditions of the EWA EIR/EIS.

4.1.1.2 Effect Assessment Methods

Extensive hydrologic, water temperature, and early lifestage salmon mortality modeling was performed to provide a quantitative basis from which to assess potential EWA-related diversion-related effects on fisheries resources and aquatic habitats within the Upstream from the Delta Region. Different methods and criterion have been employed to assess the parameters specific to each of the different types of water bodies that support fisheries and aquatic resources within this region. For instance, riverine environments primarily rely upon flow and water temperature as the criteria used to evaluate effects on anadromous and riverine fish.

Several models were used in this analysis, including CALSIM II, a Yuba River basin model, post-processing tools, reservoir temperature models, American and Sacramento water temperature models, and the lower American and Sacramento River Chinook salmon early lifestage mortality models. Appendix B of this ASIP provides a detailed discussion of the modeling process and its application to the EWA Proposed Action, including: a) the primary assumptions and model inputs used to represent hydrologic, regulatory, structural and operational conditions; and b) the simulations performed from which effects were estimated.

Modeling output provided monthly values for each year of the 72-year period of record modeled for river flows, reservoir storage and elevation, and for each year of the 69-year hydrologic simulation period modeled for river water temperatures. The period of record for water temperature modeling is shorter because it is based on records through 1990, whereas the period of record for CALSIM II extends through 1993. River water temperature output was then used in Reclamation's Chinook salmon mortality models to characterize water temperature-induced losses of early lifestages of Chinook salmon under each simulated condition. Output from the salmon mortality models provided estimates of annual (rather than monthly mean) losses of emergent fry from egg potential (all eggs brought to the river by spawning adults), which is presented in terms of survival. Diversion-related resource assessments are based on comparisons made between computer model simulations that represent the basis of comparison and the EWA Proposed Action hydrologic conditions.

The models used in this analysis are tools that have been developed for comparative planning purposes, rather than for predicting actual river conditions at specific locations and times. The 72-year and 69-year periods of record for CALSIM II and temperature modeling, respectively, provide an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions. Reservoir storage, river flows, water temperature, and salmon survival output for the period modeled should not be interpreted or used as definitive absolutes depicting actual river conditions that will occur in the future. Rather, output for the EWA Proposed Action can be compared to that for the basis of comparison simulation to determine:

- Whether reservoir storage or river flows and water temperature would be expected to change with implementation of the EWA Proposed Action;
- The months in which potential reservoir storage and river flow and water temperature changes could occur; and,
- A relative index of the magnitude of change that could occur during specific months of particular water year types, and whether the relative magnitude anticipated would be expected to result in effects on fish resources within the Upstream from the Delta Region.

The models used, although mathematically precise, should be viewed as having "reasonable detection limits." Establishing reasonable detection limits is useful to those using the modeling output for impact assessment purposes, and prevents making inferences: 1) beyond the capabilities of the models; and 2) beyond an ability to actually measure changes. Although data from the models are reported to the nearest 1,000 acre-feet (AF), foot in elevation, cubic foot per second (cfs), tenth of a degree Fahrenheit (°F), and tenth of a percent (%) in salmon mortality, these values were rounded when interpreting differences for a given parameter between two modeling simulations. For example, two simulations having river flows at a given location within one percent of each other were considered to be essentially equivalent. Because the models also provide reservoir storage data on a monthly time step, measurable differences in reservoir storage were evaluated similarly. Similar rounding of modeled output was performed for other output parameters in order to assure the reasonableness of the effect assessments.

In-situ temperature loggers were used to collect water temperature data for the model. These loggers typically have a precision of ±0.36ºF, yielding a potential total error of 0.72ºF (Sacramento River Temperature Modeling Project 1997). Therefore, modeled differences in temperature of 0.36ºF or less could not be consistently detected in the river by actual monitoring of water temperatures. In addition, as mentioned above, output from Reclamation's water temperature models provides a "relative index" of water temperatures under the various operational conditions modeled. Output values indicate whether the temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another. Therefore, for the purposes of this effect assessment, modeled temperature changes that were within 0.3°F between modeled simulations were considered to represent no measurable change (were considered to be "essentially equivalent"). Temperature differences between modeling results of more than 0.3°F were assessed for their biological significance. This approach is considered very rigorous, because it utilizes a more conservative threshold of detection for potential water temperature changes than used in other fisheries impacts assessments. For example, USFWS and Reclamation, in the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (USFWS *et al.* 1999), used a change in long-term average water temperature of 0.5°F as a threshold of significance, and the Central Valley Regional Water Quality Control Board (RWQCB) generally uses a change of 1.0°F or more as a threshold of significance.

Effect indicators such as water temperature and flows are used to evaluate if the Proposed Action will have an adverse effect on the species' habitat and range. Exceedance of monthly mean water temperatures identified by NOAA Fisheries for certain species (56ºF at Bend Bridge from April 15 through September 30 for winter-run Chinook salmon) is one such effect indicator. Changes in river flows and water temperatures during certain periods of the year have the potential to affect spawning, fry emergence, and juvenile emigration. Therefore, changes in monthly mean river flows and water temperatures during certain times of the year (during spawning, incubation, and initial rearing) are also used as effect indicators. Additional detailed information regarding the assessment methods utilized for each river system and the identification of associated significance criteria is included in Section 9.2.1.2, Riverine Fish Species Hydrologic and Water Temperature Modeling, of the EWA EIS/EIR.

4.1.1.3 Effects Analysis for Riverine Species

A detailed evaluation of direct and indirect effects of the EWA Proposed Action on special-status fish species within the Upstream from the Delta Region is provided in Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative, of the EWA EIS/EIR. The analysis of potential effects for each special-status fish species included in the ASIP is summarized in subsections 4.2 through 4.8.

4.1.2 Analysis of Potential Hydrologic Effects on Special-Status Fish Species Within the Delta Region

This section analyzes the potential effects of the EWA Proposed Action on the special-status fish species and associated aquatic resources within the Delta Region. Consideration of the special-status species identified in Section 4.1 in the determination of potential effects ensures compliance with federal regulatory requirements (ESA Section 7), State requirements under CESA, and NCCPA requirements, as described in Section 1.2, ASIP Process. According to NOAA Fisheries, there are no species requiring EFH consultation under the Magnuson-Stevens Conservation and Management Act related to the EWA Proposed Action. A separate analysis of the NCCP fish group "estuarine fish species" is not included because it would be redundant with the species-specific analysis of fish that are in this group, which is provided below.

4.1.2.1 Environmental Setting

San Francisco Bay and the Sacramento-San Joaquin Delta make up the largest estuary on the west coast (EPA 1993). The Bay-Delta estuary provides habitat for a diverse assemblage of fish and macroinvertebrates. Many of the fish and macroinvertebrate species inhabit the estuary year-round, while other species inhabit the system on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing. The geographic distribution of species within the estuary is determined, in part, based upon salinity gradients, which range from freshwater within the Sacramento and San Joaquin river systems to marine conditions near the Golden Gate Bridge. The abundance, distribution, and habitat use by these fish and macroinvertebrates has been monitored over a number of years through investigations conducted by CDFG, USFWS, NOAA Fisheries, DWR, and a number of other investigators. Results of these monitoring programs have shown changes in species composition and abundance within the system over the past several decades. Many of the fish and macroinvertebrate species have experienced a generally declining trend in abundance with several native species, including winter-run and spring-run Chinook salmon, steelhead, delta smelt, and Sacramento splittail, currently treated as a federally listed threatened species under FESA. Portions of the estuary have been identified as critical habitat for species such as winter-run Chinook salmon and delta smelt. A number of fish and macroinvertebrate species inhabiting the estuary also support recreational and commercial fisheries, such as fall-run Chinook salmon, Bay shrimp, Pacific herring, northern anchovy, starry flounder, striped bass, largemouth bass, and many others, and hence the estuary also has been identified as EFH for these species.

Many factors have contributed to the decline of fish species within the Delta, including changes in hydrologic patterns resulting from water project operations, loss of habitat, contaminant input, entrainment in diversions, and introduction of non-native species. The Delta is a network of channels through which water, nutrients, and aquatic food resources are moved and mixed by tidal action. Pumps and siphons divert water for Delta irrigation and municipal and industrial use or into CVP and SWP canals. River inflow, Delta Cross Channel operations, and diversions (including agricultural and municipal diversions and export pumping) affect Delta species through changes in habitat conditions (e.g., salinity intrusion), and mortality attributable to entrainment in diversions.

The majority of land in the Delta, which covers approximately 678,200 acres, is irrigated cropland (CALFED 2000). Other terrestrial habitats include *"riparian vegetation, wetlands, and other forms of 'idle land'"* (CALFED 2000). The CALFED PEIS/EIR describes the Delta aquatic environment as comprised of "…*channels, sloughs, and other open water. Under existing conditions, most of the open water is deep-channel habitat that has been modified to provide passage for ocean-going vessels as well as efficient conveyance of fresh water from the Sacramento River through the Delta. Vegetation is removed from levees, primarily to facilitate inspection, repair, and flood fighting when necessary. Although current flood protection programs may allow for properly managed vegetation, the amount of shallow water and shaded riverine habitat throughout the Delta is much lower now than it was historically, largely having been replaced by a patchwork of agricultural islands and revetted levees*" (CALFED 2000).

Seasonal and interannual variability in hydrologic conditions, including the magnitude of flows into the Bay-Delta estuary from the Sacramento and San Joaquin rivers and other tributaries and the outflow from the Delta into San Francisco Bay, have been identified as important factors affecting habitat quality and availability, and abundance for a number of fish and invertebrate species within the Bay-Delta estuary. Flows within the Bay-Delta system may affect larval and juvenile transport and dispersal, water temperatures (primarily within the upstream tributaries), dissolved oxygen concentrations (e.g., during the fall within the lower San Joaquin River), and salinity gradients within the estuary. The seasonal timing and geographic location of salinity gradients are thought to be important factors affecting habitat quality and availability for a number of species (Baxter *et al.* 1999). Operations of upstream storage impoundments, in combination with natural hydrologic conditions, affect seasonal patterns in the distribution of salinity within the system. Water project operations, for example, may result in a reduction in Delta inflows during the late winter and spring with an increase in Delta inflows, when compared to historical conditions, during the summer months. Objectives have been established for the location of salinity gradients during the late winter and spring to support estuarine habitat for a number of species (the X_2 location), in addition to other salinity criteria for municipal, agricultural, and wetland benefits. Although a number of studies have focused on the effects of variation in salinity gradients as a factor affecting estuarine habitat during the late winter and spring (Kimmerer 2002), very little information exists on the effects of increased inflows into the Delta during summer months and the resulting changes in salinity conditions (e.g., reduced salinity when compared to historical conditions) on the abundance, growth, survival, and distribution of various fish and macroinvertebrates inhabiting the Bay-Delta system.

Despite the high degree of habitat modification that has occurred in the Delta, Delta habitats are of key importance to fisheries, as illustrated by the more than 120 fish species that rely on its unique habitat characteristics for one or more of their lifestages (EPA 1993). Fish species found in the Delta include anadromous species, as well as freshwater, brackish water, and saltwater species. The Delta provides spawning and nursery habitat for more than 40 resident and anadromous fish species, including delta smelt, Sacramento splittail, American shad, and striped bass. The Delta also is a migration corridor and seasonal rearing habitat for Chinook salmon and steelhead. All anadromous fish of the Central Valley either migrate through the Delta to spawn and rear upstream or are dependent on the Delta to support some critical part of their life cycle. Delta smelt, which have been listed as threatened under both FESA and CESA, and Sacramento splittail, treated as a federally listed threatened species under FESA, reside year-round within the Delta. Species such as green sturgeon utilize the Delta as a migratory corridor, juvenile nursery, and adult foraging habitat, with spawning occurring further upstream within the mainstem Sacramento River. Longfin smelt, which have been identified as a species of special concern, inhabit the Delta estuary year-round. Other species which have been listed for protection under FESA or CESA, including winter-run and spring-run Chinook salmon and steelhead, utilize the estuary as a migratory corridor and as juvenile foraging habitat, with spawning and egg incubation occurring further upstream within the Sacramento and San Joaquin river systems.

Delta inflow and outflow are important for species residing primarily in the Delta (e.g., delta smelt and longfin smelt) (USFWS 1994), as well as juveniles of anadromous species (e.g., Chinook salmon) that rear in the Delta prior to ocean entry. Seasonal Delta inflows affect several key ecological processes, including: 1) the migration and transport of various lifestages of resident and anadromous fishes using the Delta (EPA, 1992); 2) salinity levels at various locations within the Delta as measured by the location of X_2; and 3) the Delta's primary (phytoplankton) and secondary (zooplankton) production.

A detailed description of the Delta is provided in Section 9.1.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR. Section 9.1.2 of the EWA EIS/EIR and subsequent subsections describe the aquatic habitats and fish populations within the Delta, and borrows heavily from the Interim South Delta Program (ISDP) Draft EIS/EIR (DWR and USBR 1996). It is organized into the following components: 1) a description of the Bay-Delta estuary; 2) a description of the principle hydraulic features of the Sacramento and San Joaquin rivers and the Delta that affect aquatic resources, including components of the CVP and SWP; and 3) descriptions of the status, life history, and factors affecting abundances of selected fish and invertebrate species, focusing on those species having economic importance or those identified as species of concern by the federal or state government.

4.1.2.2 Effect Assessment Methods

Delta outflow, X_2 location, E/I ratio, and frequency and magnitude of reverse flows (QWEST) have been identified as indicators of fishery habitat quality and availability within the Delta. Results of hydrologic modeling over a 15-year period of record were used to assess the potential effects of the EWA Proposed Action on habitat conditions within the Delta supporting fish and macroinvertebrates. Comparative analyses of monthly hydrologic modeling results between the basis of comparison and the EWA Proposed Action were used to assess changes in potential habitat conditions based on: 1) Delta outflow; 2) X_2 location; 3) E/I ratio; and 4) the frequency and magnitude of reverse flow (QWEST). In addition, results of hydrologic modeling were used to compare salvage at the SWP and CVP facilities for Chinook salmon, steelhead, splittail, and delta smelt under the basis of comparison and with operations under the EWA Proposed Action. Additional detailed information regarding the assessment methods utilized within the Delta and the identification of associated significance criteria is included in Section 9.1.2.3, Combined Downstream Effects of the SWP and CVP Facilities, of the EWA EIS/EIR.

The evaluation of potential effects on Delta fisheries involves two study scenarios, including: 1) the Maximum Water Purchase Scenario, and 2) the Typical Water Purchase Scenario. Although the Maximum Water Purchase Scenario represents potential worst-case effects on fish resources upstream from the Delta, the Typical Water Purchase Scenario was developed to analyze a more likely representation of potential worst-case effects within the Delta. Potential effects on fish resources within the Delta with implementation of the Proposed Action were analyzed under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario. Appendix B, Modeling Description, of this ASIP provides a more detailed discussion of the these two scenarios, the modeling process, and its application to the EWA Proposed Action, including: a) the primary assumptions and model inputs used to represent hydrologic, regulatory, structural and operational conditions; and b) the simulations performed from which effects were estimated.

Although habitat conditions within the Delta are important to fish and macroinvertebrates year-round, many of the species spawn and utilize the estuary as larval and juvenile rearing habitat and/or as a migratory corridor during the late winter and early spring. As a result, analysis of hydrologic modeling results as indicators of habitat conditions focused primarily on the seasonal period from February through June based on the life-cycle of many of the species inhabiting the system. Analyses also were conducted to identify and evaluate potential effects on habitat conditions during all months.

Calculations of salvage loss at the SWP and CVP, as a function of changes in the seasonal volume of water diverted, have also been used as an indicator of potential effects resulting from changes in water project operations. Export operations of the SWP and CVP directly affect mortality of fish within the Delta as a consequence of entrainment and associated stresses. The magnitude of direct losses resulting from export operations is a function of the magnitude of monthly water exports from each facility and the density (number per acre-foot) of fish vulnerable to entrainment at the facilities. Results of the hydrologic modeling provide estimates of the average monthly export operations for both the SWP and CVP under basis of comparison conditions and EWA operations. Extensive data are available on species-specific salvage at both the SWP and CVP facilities for use in estimating the risk of fishery losses. Average densities (number per acre-foot) were calculated monthly for both the SWP and CVP facilities for selected fish species over a range of water year conditions (e.g., wet, above normal, below normal, dry, and critical years). Data selected for use in these analyses extended over a 15-year period from 1979 to 1993. This data period was selected based on consideration of the reliability of salvage data (e.g., accurate species identification, expansion calculations, etc.) and the hydrologic model period, which extended through 1993.

SWP and CVP estimates of direct loss were calculated for the following fish species:

- Chinook salmon;
- Steelhead;
- Delta smelt; and
- Sacramento splittail.

An index of salvage was developed for purposes of evaluating the incremental effects of EWA operations on direct losses at the export facilities. The salvage index was derived using records of species-specific salvage at the SWP and CVP facilities, which was used to calculate the average monthly density (number of fish per TAF), which could then be multiplied by the calculated SWP and CVP monthly exports (in TAF) obtained from the hydrologic modeling output. The salvage index was calculated separately for the SWP and CVP export operations under both the basis of comparison and EWA operations. The resulting salvage index was then used to determine the incremental benefits (reduced salvage) and incremental impacts (increased salvage) calculated to result from EWA operations.

Average monthly salvage densities for each species were calculated from daily salvage records over the period from 1979 through 1993 (R. Brown, unpublished data; CDFG, unpublished data). Based on the daily salvage, expanded for sub-sampling effort, a daily density estimate was calculated using the actual water volume diverted at each of the two export facilities. The daily density estimates were then averaged to calculate an average monthly density. For consistency, the average monthly density of each of the individual target species was then used to calculate the salvage index for the period from January 1979 through September 1993 using hydrologic modeling results for the basis of comparison operation and operations under EWA. After calculating the monthly salvage index for each species assuming EWA operations, the basis of comparison estimate was subtracted from the monthly salvage index for each species to determine the net difference in salvage estimates (EWA operations – basis of comparison estimate = net change) that are anticipated to occur with implementation of the Proposed Action.

For purposes of evaluating potential impacts and benefits of EWA operations on fish salvage, the incremental difference in the annual salvage indices reflect the benefit (reduced salvage under EWA operations) as a negative index and an incremental adverse impact (increased salvage under EWA operations) as a positive index.

4.1.2.3 Effects Analysis for Estuarine Species

An analysis of potential effects related to implementation of the Proposed Action under the Maximum Water Purchase Scenario is presented first (Section 4.1.2.3.1), followed by an analysis of potential effects related to implementation of the Proposed Action under the Typical Water Purchase Scenario (Section 4.1.2.3.2). These analyses are identical to those provided in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR. A summary of potential effects within the Delta on each special-status species with implementation of the Proposed Action is provided in Sections 4.2 through 4.8 of this ASIP.

4.1.2.3.1 Maximum Water Purchase Scenario

Delta Outflow

Delta outflow provides an indicator of freshwater flow passing through the Delta and habitat conditions further downstream within San Pablo Bay and Central San Francisco Bay. Delta outflow affects salinity gradients within these downstream bays and the geographic distribution and abundance of various fish and macroinvertebrates (Baxter *et al.* 1999).

Reductions in long-term average Delta outflow under the Maximum Water Purchase Scenario would not occur with implementation of the Proposed Action, relative to the basis of comparison, as shown in Table 4-1. Delta outflow during the period of February through June is believed to be of greatest concern for potential effects on spawning and rearing habitat and downstream transport flows for delta smelt, splittail, salmonids, and other aquatic species in the Delta. Long-term average Delta outflow would increase by approximately 2.9 to 7.7 percent during the February through June period. Monthly mean flows under the Proposed Action would be essentially equivalent to or greater than flows under the basis of comparison in all months included in the simulation [Appendix H pgs. A1-A12 of the EWA EIS/EIR]. Detectable decreases in Delta outflow would not occur with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, in any of the 75 months simulated for the February through June period.

Table 4-1. Long-term Average Delta Outflow Under Basis of Comparison and Proposed Action (Maximum Water Purchase Scenario) Conditions

Month	Monthly Mean Flow[1] (cfs)		Difference	
	Basis of Comparison	Proposed Action	(cfs)	(%)[2]
Oct	7,494	7,494	0	0
Nov	14,729	14,729	0	0
Dec	29,135	29,762	627	2.2
Jan	35,403	36,000	597	1.7
Feb	57,924	58,824	900	1.6
Mar	53,136	54,665	1,529	2.9
Apr	29,039	30,674	1,635	5.6
May	17,995	19,372	1,377	7.7
Jun	13,767	14,792	1,025	7.4
Jul	7,915	8,354	439	5.6
Aug	4,192	4,492	300	7.2
Sep	5,574	5,884	310	5.6

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

X_2 Location

The location of the 2 ppt salinity near-bottom isohaline (X_2 location) has been identified as an indicator of estuarine habitat conditions within the Bay-Delta system. The location of X_2 within Suisun Bay during the February through June period is thought to be directly and/or indirectly related to the reproductive success and survival of the early lifestages for a number of estuarine species. Results of statistical regression analyses suggest that abundance of several estuarine species is greater during the spring when the X_2 location is within the western portion of Suisun Bay, with lower abundance correlated with those years when the X_2 location is farther to the east near the confluence between the Sacramento and San Joaquin rivers.

Under implementation of the Proposed Action under the Maximum Water Purchase Scenario, the long-term average position of X_2 would not shift upstream during any month, as shown in Table 4-2. In addition, the monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, in all of the 75 months simulated with implementation of the Proposed Action under the Maximum Water Purchase Scenario for this period [Appendix H pgs. A13-A24 of the EWA EIS/EIR].

Table 4-2. Long-term Average Delta X_2 Position Under Basis of Comparison and Proposed Action (Maximum Water Purchase Scenario) Conditions

Month	Monthly Mean Position[1] (km)		
	Basis of Comparison	**Proposed Action**	**Difference**
Oct	85.3	84.5	-0.8
Nov	83.6	83.4	-0.2
Dec	80.3	80.2	-0.1
Jan	76.9	76.6	-0.3
Feb	71.7	71.3	-0.4
Mar	66.4	66.0	-0.4
Apr	64.5	63.8	-0.7
May	67.8	67.0	-0.8
Jun	72.0	70.9	-1.1
Jul	75.9	74.7	-1.2
Aug	79.5	78.6	-0.9
Sep	84.5	83.6	-0.9

[1] Kilometers from the Golden Gate Bridge.

<u>Export/Inflow Ratio</u>

Exports from the SWP and CVP result in direct effects, including salvage and entrainment losses, for many fish and macroinvertebrates. Export operations also are thought to indirectly affect survival; however, indirect effects have been difficult to quantify. The ratio between exports and Delta inflow (E/I ratio) has been identified as an indicator of the vulnerability of fish and macroinvertebrates to direct and indirect effects resulting from SWP and CVP operations. The E/I ratio limits are identified in the 1995 Water Quality Control Plan, with the greatest reductions in exports relative to inflows occurring during the biologically sensitive February through June period.

The long-term average E/I ratio with implementation of the Proposed Action under the Maximum Water Purchase Scenario would decrease during all months of the February through June period, relative to the basis of comparison, as shown in Table 4-3. The monthly mean E/I ratio with implementation of the Proposed Action under the Maximum Water Purchase Scenario would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the 75 months simulated for the February through June period [Appendix H pgs. A49-A60 of the EWA EIS/EIR].

Table 4-3. Long-term Average Delta E/I Ratio Under Basis of Comparison and Proposed Action (Maximum Water Purchase Scenario) Conditions				
Month	Monthly Mean Ratio[1] (%)		Difference	
	Basis of Comparison	Proposed Action	(%)	(%)[2]
Oct	49	49	0	0
Nov	39	39	0	0
Dec	37	34	-3	-8.1
Jan	36	34	-2	-5.6
Feb	23	20	-3	-13.0
Mar	21	17	-4	-19.0
Apr	18	12	-6	-33.3
May	20	13	-7	-35.0
Jun	27	22	-5	-18.5
Jul	32	36	+4	+12.5
Aug	51	55	+4	+7.8
Sep	57	60	+3	+5.3

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

The model simulations conducted for the Proposed Action included conformance with export requirements set forth in the SWRCB Interim Water Quality Control Plan. Thus, the Delta E/I ratios under the Proposed Action and basis of comparison would not exceed the maximum export ratio as set by the SWRCB Interim Water Quality Control Plan [Appendix H pgs. A49-A60 of the EWA EIS/EIR]. However, relaxation of the E/I ratio is an EWA asset. If the Management Agencies determine that the risk to fish is relatively low, then pumping above the applicable limit for brief periods may be undertaken, with the additional water credited to the EWA. Such actions will not be taken if there is the potential to affect State or federally protected species, and will only be taken under the unanimous direction of the Management Agencies.

<u>Reverse Flows (QWEST)</u>
Reverse flows (also referred to as QWEST) have been identified as an indicator of the potential risk of adverse effects on planktonic fish eggs and larvae and the survival of downstream migrating juvenile Chinook salmon smolts. The potential for adverse effects associated with reverse flow is greatest during the late winter-spring period (February through June). Reverse flows occur primarily when freshwater inflow is low and export pumping is high, causing the lower San Joaquin River to change direction and flow upstream. Reversed flows are evaluated based on model simulations of the direction and magnitude of flows in the lower San Joaquin River in the vicinity of Jersey Point.

Under the basis of comparison, reverse flows would occur in 25 months out of the 75 months simulated for the February through June period (33.3 percent of the time). Reverse flows would occur less frequently with implementation of the Proposed Action under the Maximum Water Purchase Scenario, in 13 of the 75 months simulated, or 17.3 percent of the time [Appendix H pgs. A41-A45 of the EWA EIS/EIR]. Table 4-4 illustrates that the frequency of reverse flows under the Proposed

Action would be substantially reduced across all flow ranges during February through June, relative to the basis of comparison. In most months in which reverse flows would occur under the basis of comparison, flows would be positive or the magnitude of reverse flow substantially reduced under the Maximum Water Purchase Scenario [Appendix H pgs. A41-A45 of the EWA EIS/EIR].

Overall, implementation of the Proposed Action under the Maximum Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Such changes would be considered a benefit to juvenile salmonid emigration and the transport of planktonic eggs and larvae. Therefore, implementation of the Proposed Action may beneficially affect the survival of planktonic fish eggs and larvae and downstream migrating juvenile Chinook salmon smolts. In addition, changes in Delta outflows, the position of X_2, and the E/I ratios resulting from implementation of the Proposed Action under the Maximum Water Purchase Scenario are not likely to adversely affect delta smelt, splittail, steelhead, fall-, late-fall-, winter-, or spring-run Chinook salmon in the Delta.

<u>Salvage at the SWP and CVP Export Facilities</u>
Salvage estimates for delta smelt, Chinook salmon, steelhead, and splittail, were developed based upon historical salvage records, which exhibit variation due to interannual variability in the abundance and distribution of each species. Salvage modeling, described in Section 9.2.1.3, Estuarine Fish Species in the Delta, of the EWA EIS/EIR provides an indication of the relative effect of CVP and SWP pumping operations with implementation of the Proposed Action (Flexible Purchase Alternative) and under the basis of comparison. This section provides an analysis of potential salvage-related effects with implementation of the Proposed Action under the Maximum Water Purchase Scenario on delta smelt, Chinook salmon, steelhead, and splittail.

Delta Smelt
Under the Proposed Action (Maximum Water Purchase Scenario), a net reduction in delta smelt salvage would occur over the 15-year period of record included in the analysis, relative to the basis of comparison. Average annual salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario decrease by 135,887 delta smelt relative to the basis of comparison [Table 4-5 below].

Annual and monthly changes in delta smelt salvage estimates with implementation of the Proposed Action, relative to the basis of comparison, over the 15-year period of record included in the analysis under the Maximum Water Purchase scenario are provided in Table 4-5. Annual salvage estimates decrease in every year by 293 to 66,002 delta smelt, relative to the basis of comparison, except for one year (in 1991 there is an estimated increase of 398 delta smelt), as shown in Table 4-5. Monthly mean delta smelt salvage estimates under the Proposed Action would not change during October and November, relative to the basis of comparison. From December through July, implementation of the Proposed Action under the Maximum Water

Purchase Scenario would result in monthly mean reductions in salvage ranging from 2,358 to 61,929 delta smelt, relative to the basis of comparison. During August and September, monthly mean salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario would increase by 4,763 and 1,117 delta smelt, respectively, relative to the basis of comparison.

Table 4-4. Frequency[1] of Reverse Flows (QWEST) Over Varying Flow Ranges

Reverse Flow Range (cfs)	Basis of Comparison	Proposed Action (Maximum Water Purchase Scenario)
February		
<0	6	5
<-100	4	3
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
March		
<0	6	1
<-100	3	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
April		
<0	2	1
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
May		
<0	5	2
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
June		
<0	6	4
<-100	3	1
<-250	1	1
<-500	0	0
<-1000	0	0
<-2000	0	0

[1] Based on the 15-year period of record for each month.

While annual salvage estimates exhibit a decrease in 14 of the 15 years simulated with implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be isolated occurrences of increases in delta smelt salvage in 34 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual delta smelt salvage in 14 of the 15 years simulated.

Table 4-5. Change in Delta Smelt Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-125	-188	-337	-1,350	-3,121	-2,440	2,463	181	15	-4,902
1980	0	0	0	-188	-348	-408	-816	-238	-9,006	915	3,314	105	-6,668
1981	0	0	-416	0	-1,128	-6,552	-1,522	-37,501	-3,836	-15,305	235	24	-66,002
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,932	852	0	245	-3,191
1984	0	0	0	0	-2	-186	-50	-5,046	-1,553	761	3	9	-6,065
1985	0	0	-340	0	-30	-57	-282	-456	-7,955	63	34	50	-8,973
1986	0	0	-20	-71	-356	-241	-128	-26	-39	112	166	0	-603
1987	0	0	-22	-5	-53	-357	-3,402	-3,886	-5,925	-892	75	150	-14,319
1988	0	0	-1,337	-862	-100	0	0	-4,816	0	418	0	0	-6,697
1989	0	0	0	-44	-6	-32	-40	-366	-581	-1,884	74	31	-2,848
1990	0	0	0	-27	-80	-56	0	0	-7,656	960	2	0	-6,857
1991	0	0	0	0	0	-213	-121	-857	0	880	261	448	398
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-89	-59	-49	0	-5,389	-1,681	293	5	0	-6,970
Total	0	0	-2,358	-3,063	-3,964	-9,347	-7,814	-61,929	-43,642	-9,651	4,763	1,117	-135,887

As discussed in Section 4.6.4, Conservation Measures and Expected Outcomes, real-time operations would be implemented as needed to avoid pumping operations that would result in increased delta smelt salvage. Overall, based on modeling output and the efficiency of real-time adjustment of operations (real-time implementation of conservation measures) in response to abundance and distribution monitoring, implementation of the Proposed Action under the Maximum Water Purchase Scenario is not likely to adversely affect delta smelt.

Chinook Salmon

With implementation of the Proposed Action under the Maximum Water Purchase Scenario, a net reduction in Chinook salmon salvage would occur over the 15-year period of record, relative to the basis of comparison. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison [Table 4-6 below].

Annual and monthly changes in Chinook salmon salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, are provided in Table 4-6. Annual salvage estimates decrease in every year by 2,529 to 320,526 Chinook salmon, relative to the basis of comparison, as shown in Table 4-6. Monthly mean Chinook salmon salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean decreases in salvage ranging from 7,383 to 444,219 Chinook salmon, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase

Scenario would increase by 2,742, 286, and 555 Chinook salmon, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be isolated occurrences of increases in SWP Chinook salmon salvage in 24 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual salvage in any year simulated over the 15-year period of record included in the analysis. Thus, while there would be increases in Chinook salmon salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario in individual months of the simulation, annual salvage estimates for Chinook salmon would decrease, relative to the basis of comparison. Such changes are not likely to adversely affect Chinook salmon.

Table 4-6. Change in Chinook Salmon Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-586	-197	-700	-55,499	-55,646	-1,570	1,450	75	28	-112,645
1980	0	0	-466	-238	-27	-20	-86,314	-54,922	-16,405	-567	10	519	-158,431
1981	0	0	-102	0	-156	-5,630	-24,295	-15,608	-64	0	14	0	-45,839
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-37,634	284	0	0	-88,189
1984	0	0	0	0	-6	-1,290	-45,834	-46,789	-16,714	4	133	0	-110,496
1985	0	0	-1,625	0	-362	-829	-16,828	-48,989	-10,555	29	0	2	-79,156
1986	0	0	-399	-190	-93,319	-25,239	-57,136	-86,099	-59,386	1,244	0	0	-320,526
1987	0	0	-94	-27	-78	-4,394	-16,697	-11,139	-4,062	15	2	3	-36,471
1988	0	0	-4,804	-1,015	-913	0	-1,902	-14,700	0	248	21	2	-23,062
1989	0	0	0	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,701
1990	0	0	-51	-298	-164	-744	0	0	-1,273	1	0	0	-2,529
1991	0	0	0	0	0	-1,355	-3,919	-7,895	0	0	0	0	-13,169
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-51	-67	-122	-4,429	-4,236	-238	2	21	0	-9,120
Total	0	0	-25,617	-7,383	-103,545	-53,091	-329,762	-444,219	-163,792	2,742	286	555	-1,123,826

Steelhead

A net reduction in steelhead salvage would occur with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates under the Maximum Water Purchase Scenario would be reduced by 28,928 steelhead, relative to the basis of comparison [Table 4-7].

Annual and monthly changes in salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, are shown in Table 4-7. Annual salvage would decrease in every year by 293 to 4,085 steelhead, relative to the basis of comparison, as shown in Table 4-7. Monthly mean steelhead salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would not change from August through November, relative to the basis of comparison. From December through

June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 428 to 12,182 steelhead, relative to the basis of comparison. During July, monthly mean salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would increase by five steelhead, relative to the basis of comparison. Such changes are not likely to adversely affect steelhead.

Table 4-7. Change in Steelhead Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-34	-93	-260	-1,425	-775	0	0	0	0	-2,588
1980	0	0	-2	-15	-48	-7	-738	-671	-55	0	0	0	-1,536
1981	0	0	-12	0	-132	-2,397	-1,452	-92	0	0	0	0	-4,085
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-261	-8	0	0	0	0	-293
1985	0	0	-2	0	-18	-145	-353	-163	0	0	0	0	-682
1986	0	0	0	-2	-144	-71	-423	-182	0	5	0	0	-815
1987	0	0	-138	-9	-12	-2,715	-546	-81	0	0	0	0	-3,500
1988	0	0	-83	-55	-189	0	-164	-170	0	0	0	0	-661
1989	0	0	0	-2	-42	-1,464	-34	-26	0	0	0	0	-1,568
1990	0	0	0	0	-383	-846	0	0	0	0	0	0	-1,230
1991	0	0	0	0	0	-1,988	-206	-31	0	0	0	0	-2,225
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-39	-588	-928	-395	-314	0	0	0	0	-2,264
Total	0	0	-1,024	-550	-2,810	-12,182	-7,826	-4,114	-428	5	0	0	-28,928

Splittail

With implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be a net reduction in splittail salvage, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would decrease by 1,014,290 splittail, relative to the basis of comparison [Table 4-8].

Annual and monthly change in splittail salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis are provided in Table 4-8. Annual salvage estimates decrease in every year by 628 to 699,086 splittail, relative to the basis of comparison, except for one year (in 1984 there is an estimated increase of 603 splittail), as shown in Table 4-8. Monthly mean splittail salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 1,673 to 575,902 splittail, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would increase by 60,415, 34,596, and 2,996 splittail, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease in 14 of the 15 years simulated with implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be isolated occurrences of increases in splittail salvage in 35 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual splittail salvage in 14 of the 15 years simulated.

Table 4-8. Change in Splittail Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-1	-38	-398	-1,479	-9,931	-10,819	2,979	778	71	-18,838
1980	0	0	-91	-1,613	-3,254	-69	-4,310	-23,974	-66,341	46	2,198	341	-97,068
1981	0	0	-20	0	-299	-1,819	-2,823	-29,018	0	0	16	0	-33,963
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-59,762	9,261	4,804	194	-61,192
1984	0	0	0	0	-218	-1,114	-2,807	-2,315	-3,868	8,776	1,941	208	603
1985	0	0	-138	0	-371	-677	-1,662	-700	-14,563	383	78	20	-17,630
1986	0	0	0	-10	-356	-2,094	-16,567	-368,329	-339,879	22,726	3,675	1,748	-699,086
1987	0	0	-89	-74	-268	-2,357	-642	-373	-54,289	-436	96	106	-58,326
1988	0	0	-518	-2,602	-1,315	0	-259	-1,378	0	1,178	24	47	-4,824
1989	0	0	0	-32	-83	-1,351	-104	-2,308	-670	-994	455	79	-5,008
1990	0	0	-6	-132	-757	-1,192	0	0	0	1,459	0	0	-628
1991	0	0	0	0	0	-1,337	-648	-1,329	0	459	0	0	-2,855
1992	0	0	0	-35	-642	-839	-22	0	0	0	55	0	-1,482
1993	0	0	0	-1,439	-457	-448	-1,459	-2,489	-2,114	675	89	16	-7,627
Total	0	0	-1,673	-7,675	-15,292	-16,502	-34,572	-460,681	-575,902	60,415	34,596	2,996	-1,014,290

Although there would be increases in splittail salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario in one year and in individual months of the simulation, annual splittail salvage estimates would decrease in 14 of the 15 years simulated, relative to the basis of comparison. Such changes are not likely to adversely affect splittail.

4.1.2.3.2 Typical Water Purchase Scenario

Delta Outflow

Reductions in long-term average Delta outflow under the Typical Water Purchase Scenario would not occur with implementation of the Proposed Action, relative to the basis of comparison, as shown in Table 4-9. Delta outflow during the period of February through June is believed to be of greatest concern for potential effects on spawning and rearing habitat and downstream transport flows for delta smelt, splittail, salmonids, and other aquatic species in the Delta. Long-term average Delta outflow would increase by approximately 1.3 to 6.9 percent during the February through June period. Monthly mean flows with implementation of the Proposed Action under the Typical Water Purchase Scenario would be essentially equivalent to or greater than flows under the basis of comparison in all months included in the simulation [Appendix H pgs. B1-B12 of the EWA EIS/EIR]. Detectable decreases in Delta outflow would not occur with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, in any of the 75 months simulated for the February through June period.

Table 4-9. Long-term Average Delta Outflow Under Basis of Comparison and Proposed Action (Typical Water Purchase Scenario) Conditions

Month	Monthly Mean Flow[1] (cfs)		Difference	
	Basis of Comparison	Proposed Action	(cfs)	(%)[2]
Oct	7,494	7,494	0	0
Nov	14,729	14,729	0	0
Dec	29,135	29,669	534	1.8
Jan	35,403	35,805	401	1.1
Feb	57,924	58,656	732	1.3
Mar	53,136	54,123	987	1.9
Apr	29,039	30,111	1072	3.7
May	17,995	19,082	1087	6.0
Jun	13,767	14,718	950	6.9
Jul	7,915	8,280	365	4.6
Aug	4,192	4,476	284	6.8
Sep	5,574	5,867	293	5.3

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

X_2 Location

With implementation of the Proposed Action under the Typical Water Purchase Scenario, the long-term average position of X_2 would not shift upstream during any month of the February through June period, as shown in Table 4-10. In addition, the monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, in all of the 75 months simulated with implementation of the Proposed Action under the Typical Water Purchase Scenario [Appendix H pgs. B13-B24 of the EWA EIS/EIR].

Table 4-10. Long-term Average Delta X_2 Position Under Basis of Comparison and Proposed Action (Typical Water Purchase Scenario) Conditions

Month	Monthly Mean Position[1] (km)		
	Basis of Comparison	Proposed Action	Difference
Oct	85.3	84.5	-0.8
Nov	83.6	83.4	-0.2
Dec	80.3	80.3	0
Jan	76.9	76.6	-0.3
Feb	71.7	71.5	-0.2
Mar	66.4	66.1	-0.3
Apr	64.5	64.1	-0.4
May	67.8	67.3	-0.5
Jun	72.0	71.2	-0.8
Jul	75.9	74.8	-1.1
Aug	79.5	78.7	-0.8
Sep	84.5	83.7	-0.8

[1] Kilometers from the Golden Gate Bridge.

Export/Inflow Ratio

The long-term average E/I ratio with implementation of the Proposed Action under the Typical Water Purchase Scenario would decrease during all months of the February through June period, relative to the basis of comparison, as shown in Table 4-11. The monthly mean E/I ratio with implementation of the Proposed Action under the Typical Water Purchase Scenario would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the 75 months simulated for the February through June period [Appendix H pgs. B49-B60 of the EWA EIS/EIR].

Table 4-11. Long-term Average Delta E/I Ratio Under Basis of Comparison and Proposed Action (Typical Water Purchase Scenario) Conditions

Month	Monthly Mean Ratio[1] (%)		Difference	
	Basis of Comparison	Proposed Action	(%)	(%)[2]
Oct	49	49	0	0
Nov	39	39	0	0
Dec	37	35	-2	-5.4
Jan	36	35	-1	-2.8
Feb	23	21	-2	-8.7
Mar	21	19	-2	-9.5
Apr	18	14	-4	-22.2
May	20	14	-6	-30.0
Jun	27	22	-5	-18.5
Jul	32	36	+4	+12.5
Aug	51	55	+4	+7.8
Sep	57	60	+3	+5.3

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

The model simulations conducted for the Proposed Action included conformance with export requirements set forth in the SWRCB Interim Water Quality Control Plan. Thus, the Delta E/I ratios under the Proposed Action and basis of comparison would not exceed the maximum export ratio as set by the SWRCB Interim Water Quality Control Plan [Appendix H pgs. B49-B60 of the EWA EIS/EIR]. However, relaxation of the E/I ratio is an EWA asset. If the Management Agencies determine that the risk to fish is relatively low, then pumping above the applicable limit for brief periods may be undertaken, with the additional water credited to the EWA. Such actions will not be taken if there is the potential to affect State or federally protected species, and will only be taken under the unanimous direction of the Management Agencies.

Reverse Flows (QWEST)

Under the basis of comparison, reverse flows would occur in 25 months out of the 75 months simulated for the February through June period (33.3 percent of the time). Reverse flows would occur less frequently with implementation of the Proposed Action under the Typical Water Purchase Scenario, in 16 of the 75 months simulated, or 21.3 percent of the time [Appendix H pgs. B41-B45 of the EWA EIS/EIR]. Table 4-12 illustrates that the frequency of reverse flows from February through June under the Proposed Action would be unchanged or substantially reduced across all flow ranges, relative to the basis of comparison. In most months in which reverse flows would occur under the basis of comparison, flows would be positive or the magnitude of reverse flow substantially reduced under the Typical Water Purchase Scenario [Appendix H pgs. B41-B45 of the EWA EIS/EIR].

Overall, implementation of the Proposed Action under the Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Such changes would be considered a benefit to juvenile salmonid emigration and the transport of planktonic eggs and larvae. Therefore, implementation of the Proposed Action may beneficially affect the survival of planktonic fish eggs and larvae and downstream migrating juvenile Chinook salmon smolts. In addition, changes in Delta outflows, the position of X_2, and the E/I ratios resulting from implementation of the Proposed Action under the Typical Water Purchase Scenario are not likely to adversely affect delta smelt, splittail, steelhead, fall-, late-fall-, winter-, or spring-run Chinook salmon in the Delta.

Table 4-12. Frequency[1] of Reverse Flows (QWEST) Over Varying Flow Ranges

Reverse Flow Range (cfs)	Basis of Comparison	Proposed Action (Typical Water Purchase Scenario)
February		
<0	6	6
<-100	4	3
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
March		
<0	6	3
<-100	3	1
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
April		
<0	2	1
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
May		
<0	5	2
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0

Table 4-12. Frequency[1] of Reverse Flows (QWEST) Over Varying Flow Ranges

Reverse Flow Range (cfs)	Basis of Comparison	Proposed Action (Typical Water Purchase Scenario)
June		
<0	6	4
<-100	3	1
<-250	1	1
<-500	0	0
<-1000	0	0
<-2000	0	0

[1] Based on the 15-year period of record for each month.

Salvage at the SWP and CVP Export Facilities

Salvage estimates for delta smelt, Chinook salmon, steelhead, and splittail, were developed based upon historical salvage records, which exhibit variation due to interannual variability in the abundance and distribution of each species. Salvage modeling, described in Section 9.2.1.3, Estuarine Fish Species in the Delta of the EWA EIS/EIR provides an indication of the relative effect of CVP and SWP pumping operations with implementation of the Proposed Action (Flexible Purchase Alternative). This section provides an analysis of potential salvage-related effects with implementation of the Proposed Action under the Typical Water Purchase Scenario on delta smelt, Chinook salmon, steelhead, and splittail.

Delta Smelt

Under the Proposed Action (Typical Water Purchase Scenario), a net reduction in delta smelt salvage would occur over the 15-year period of record included in the analysis, relative to the basis of comparison. Average annual salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario decrease by 93,690 delta smelt relative to the basis of comparison [Table 4-13].

Annual and monthly changes in delta smelt salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action, relative to the basis of comparison, over the 15-year period of record included in the analysis under the Typical Water Purchase scenario are provided in Table 4-13. Annual salvage estimates decrease in every year by 293 to 26,355 delta smelt, relative to the basis of comparison, as shown in Table 4-13. Monthly mean delta smelt salvage estimates under the Proposed Action would not change during October and November, relative to the basis of comparison. From December through July, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 1,533 to 41,354 delta smelt, relative to the basis of comparison. During August and September, monthly mean salvage under the Proposed Action would increase by 4,711 and 928 delta smelt, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Typical Water Purchase Scenario, there would be isolated occurrences of increases in delta smelt salvage in 31 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual delta smelt salvage for any of the 15 years simulated. In fact, annual delta smelt salvage would decrease, relative to the basis of comparison in all 15 years simulated for the analysis.

As discussed in Section 4.6.4, Conservation Measures and Expected Outcomes, real-time operations would be implemented as needed to avoid pumping operations that would result in increased delta smelt salvage. Overall, based on modeling output and the efficiency of real-time adjustment of operations (real-time implementation of conservation measures) in response to abundance and distribution monitoring, implementation of the Proposed Action under the Typical Water Purchase Scenario is not likely to adversely affect delta smelt.

Table 4-13. Change in Delta Smelt Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-42	-125	-225	-442	-1,874	-2,440	2,463	181	15	-2,489
1980	0	0	0	-188	-348	-408	-498	-127	-6,754	-8,217	3,314	105	-13,121
1981	0	0	-416	0	-1,128	-1,966	-1,036	-13,130	-3,836	-5,102	235	24	-26,355
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,199	852	0	245	-2,458
1984	0	0	0	0	-2	-186	-21	-2,895	-1,165	761	3	9	-3,496
1985	0	0	-170	0	-30	-29	-255	-906	-6,524	63	34	50	-7,765
1986	0	0	-20	-71	-356	-145	-128	-18	-19	91	104	0	-561
1987	0	0	-15	0	-35	-208	-1,301	-3,886	-5,925	-19	-21	132	-11,279
1988	0	0	-668	-287	-35	0	0	-4,816	-487	290	0	0	-6,004
1989	0	0	-21	-44	-6	-32	-40	-366	-581	441	74	31	-543
1990	0	0	0	-9	-27	-28	0	-28	-7,656	136	0	0	-7,612
1991	0	0	0	0	0	-106	-121	-531	-2,708	1,240	368	277	-1,582
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-60	-59	-33	0	-7,318	-1,022	250	5	0	-8,237
Total	0	0	-1,533	-2,352	-3,765	-4,223	-3,945	-36,121	-41,354	-6,036	4,711	928	-93,690

Chinook Salmon

With implementation of the Proposed Action under the Typical Water Purchase Scenario, a net reduction in Chinook salmon salvage would occur over the 15-year period of record, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison [Table 4-14].

Annual and monthly changes in Chinook salmon salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, are provided in Table 4-14. Annual salvage would decrease in every year by 2,117 to 252,497 Chinook salmon, relative to the basis of comparison, as shown in Table 4-14. Monthly mean Chinook salmon salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean decreases in salvage ranging from 6,073 to 356,022 Chinook salmon, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would increase by 2,181, 274, and 551 Chinook salmon, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Typical Water Purchase Scenario, there would be isolated occurrences of increases in SWP Chinook salmon salvage in 20 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual salvage in any year simulated over the 15-year period of record included in the analysis. Thus, while there would be increases in Chinook salmon salvage with implementation of the Proposed Action under the Typical Water Purchase Scenario in individual months of the simulation, annual salvage estimates for Chinook salmon would decrease, relative to the basis of comparison. Such changes are not likely to adversely affect Chinook salmon.

Table 4-14. Change in Chinook Salmon Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-195	-131	-467	-31,668	-32,892	-1,570	1,450	75	28	-65,370
1980	0	0	-466	-238	-27	-20	-60,802	-35,637	-12,304	-567	10	519	-109,532
1981	0	0	-102	0	-156	-1,689	-21,608	-12,312	-64	0	14	0	-35,916
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-28,226	284	0	0	-78,780
1984	0	0	0	0	-6	-1,290	-24,188	-29,496	-25,410	4	133	0	-80,252
1985	0	0	-812	0	-362	-415	-13,751	-56,365	-9,911	29	0	2	-81,584
1986	0	0	-399	-190	-93,319	-15,144	-57,136	-57,399	-29,693	784	0	0	-252,497
1987	0	0	-63	0	-52	-2,167	-13,631	-11,139	-4,062	-4	-1	-1	-31,120
1988	0	0	-2,402	-338	-320	0	-1,348	-14,700	-53	168	15	2	-18,978
1989	0	0	-52	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,753
1990	0	0	-51	-99	-55	-372	0	-266	-1,273	0	0	0	-2,117
1991	0	0	0	0	0	-678	-3,919	-5,484	-500	0	0	0	-10,581
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-34	-67	-81	-1,957	-2,136	-205	2	18	0	-4,461
Total	0	0	-22,424	-6,073	-102,751	-35,090	-246,917	-356,022	-129,162	2,181	274	551	-895,433

Steelhead

A net reduction in steelhead salvage would occur with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates under the Typical Water Purchase Scenario would be reduced by 20,386 steelhead, relative to the basis of comparison [Table 4-15].

Annual and monthly changes in steelhead salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, are shown in Table 4-15. Annual salvage would decrease in ever year by 180 to 4,005 steelhead, relative to the basis of comparison, as shown in Table 4-15. Monthly mean steelhead salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would not change from August through November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 414 to 7,088 steelhead, relative to the basis of comparison. During July, monthly mean salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would increase by three steelhead, relative to the basis of comparison. Such changes are not likely to adversely affect steelhead.

Splittail

With implementation of the Proposed Action under the Typical Water Purchase Scenario, there would be a net reduction in splittail salvage, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would decrease by 656,597 splittail, relative to the basis of comparison [Table 4-16].

Table 4-15. Change in Steelhead Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-11	-62	-173	-707	-473	0	0	0	0	-1,428
1980	0	0	-2	-15	-48	-7	-507	-458	-41	0	0	0	-1,078
1981	0	0	-12	0	-132	-719	-1,016	-24	0	0	0	0	-1,903
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-151	-5	0	0	0	0	-180
1985	0	0	-1	0	-18	-73	-220	-221	0	0	0	0	-532
1986	0	0	0	-2	-144	-43	-423	-121	0	3	0	0	-728
1987	0	0	-92	0	-8	-1,213	-302	-81	0	0	0	0	-1,695
1988	0	0	-42	-18	-103	0	-78	-170	0	0	0	0	-411
1989	0	0	-5	-2	-42	-1,464	-34	-26	0	0	0	0	-1,573
1990	0	0	0	0	-128	-423	0	-3	0	0	0	0	-554
1991	0	0	0	0	0	-994	-206	-24	0	0	0	0	-1,224
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-26	-588	-618	-165	-200	0	0	0	0	-1,597
Total	0	0	-941	-468	-2,434	-7,088	-5,636	-3,407	-414	3	0	0	-20,386

Annual and monthly change in splittail salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis are provided in Table 4-16. Annual salvage would decrease by 75 to 409,257 splittail, relative to the basis of comparison, as shown in Table 4-16. Monthly mean splittail salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 1,322 to 375,810 splittail, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed

Action under the Typical Water Purchase Scenario would increase by 47,272, 34,061, and 2,687 splittail, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Typical Water Purchase Scenario for each year simulated over the 15-year period of record, there would be isolated occurrences of increases in splittail salvage in 36 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual salvage in any year simulated under the Proposed Action. Thus, although there would be increases in splittail salvage with implementation of the Proposed Action under the Typical Water Purchase Scenario in individual months of the simulation, annual splittail salvage estimates would decrease, relative to the basis of comparison. Such changes are not likely to adversely affect splittail.

Table 4-16. Change in Splittail Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				0	-26	-266	-474	-4,595	-10,819	2,979	778	71	-12,351
1980	0	0	-91	-1,613	-3,254	-69	-2,861	-12,446	-49,756	-10,584	2,198	341	-78,134
1981	0	0	-20	0	-299	-546	-2,541	-8,210	0	0	16	0	-11,600
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-44,822	9,261	4,804	194	-46,251
1984	0	0	0	0	-218	-1,114	-1,615	-1,609	-6,445	8,776	1,941	208	-75
1985	0	0	-69	0	-371	-339	-963	-1,602	-7,063	383	78	20	-9,925
1986	0	0	0	-10	-356	-1,256	-16,567	-245,553	-169,939	19,755	3,198	1,472	-409,257
1987	0	0	-60	0	-178	-1,208	-389	-373	-54,289	13	63	89	-56,332
1988	0	0	-259	-867	-666	0	-136	-1,378	-614	724	16	32	-3,147
1989	0	0	-7	-32	-83	-1,351	-104	-2,308	-670	205	455	79	-3,815
1990	0	0	-6	-44	-252	-596	0	-111	0	780	0	0	-230
1991	0	0	0	0	0	-668	-648	-825	-5,886	490	0	0	-7,539
1992	0	0	0	-35	-642	-839	-22	0	0	0	50	0	-1,487
1993	0	0	0	-959	-457	-298	-648	-6,489	-1,910	585	76	14	-10,088
Total	0	0	-1,322	-5,298	-14,036	-11,357	-28,759	-304,034	-375,810	47,272	34,061	2,687	-656,597

4.1.3 Analysis of Potential Hydrologic Effects on Special-Status Fish Species Within the Export Service Area

There are no federally or state-listed anadromous, estuarine, or riverine special-status species within the Export Service Area, therefore, an impact analysis to determine potential effects on fisheries resources was not performed for the water bodies within this area. The main channelized waterway in this region is the California Aqueduct, an artificial canal that is not managed for fishery resources. There are several non-Project reservoirs within the Export Service Area that may be affected by the EWA Proposed Action, however there are no special-status fish species associated with these reservoirs. A thorough review of all fisheries impacts, including those related to the non-Project reservoirs, is presented in Chapter 9 of the EWA EIS/EIR.

4.1.4 Analysis of Potential Effects on Terrestrial Species

The reader is also referred to Chapter 5, Effects of the Proposed Action on Vegetative NCCP Communities and Covered Species, for additional details regarding the effects to the habitats of the species presented the following subsections. The terrestrial species included in this ASIP are:

- Aleutian Canada Goose (*Branta canadensis leucopareia*)
- Black Tern (*Chlidonias niger*)
- Black-crowned Night Heron (rookery) (*Nycticorax nycticorax)*
- Great Blue Heron (rookery) (*Ardea herodias*)
- Great Egret (rookery) (*Casmerodius ablus*)
- Greater Sandhill Crane (*Grus canadensis tabida*)
- Long-billed Curlew (*Numenius americanus*)
- Snowy Egret (rookery) (*Egretta thula*)
- Tricolored Blackbird (*Agelaius tricolor*)
- White-faced Ibis (*Plegadis chihi*)
- Giant Garter Snake (*Thamnophis gigas*)
- Western Pond Turtle (*Clemmys marmorata*)

4.2 Central Valley Fall-run/Late-fall-run Chinook Salmon (*Oncorhynchus tshawytscha*)

4.2.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Central Valley fall-run/late-fall-run Chinook salmon historically inhabited the entire Sacramento-San Joaquin watershed. Fish barriers (typically dams) on many streams and rivers currently limit upstream habitat. Adults migrate upstream through the Bay and Delta ecozones from summer through early winter, with the predominant period being September and October. Adults are found in river and tributary ecozones generally from late summer into winter. Most young move out of tributary spawning areas in winter and spring. Young may be found in the river, Delta, and Bay ecozones from winter into early summer. Additional details regarding the status of Central Valley fall-run/late-fall-run Chinook salmon in the EWA Action Area are provided in Section 3.2.1, Central Valley Fall-run/Late-fall-run Chinook Salmon.

4.2.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-17 presents the effect indicators and evaluation criteria used in the analysis of potential effects on fall-run/late-fall-run Chinook salmon.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Sacramento River Fall-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration period (September through November).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration period (September through November).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (October through February).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the spawning, egg incubation, and initial rearing period (October through February).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Butte Creek Fall-run Chinook Salmon	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (late-September through October).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigation for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (December through June).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Lower Feather River Fall-run Chinook Salmon	
Monthly mean flow (cfs) at the mouth of the Feather River and below the Thermalito Afterbay Outlet for each month of the adult immigration period (September through November).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean water temperature (°F) at the mouth of the Feather River and below the Thermalito Afterbay Outlet for each month of the adult immigration period (September through November).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below the Thermalito Afterbay Outlet for each month of the spawning/egg incubation and initial rearing period (October through February).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) below the Fish Barrier Dam and below the Thermalito Afterbay Outlet for each month of the spawning/egg incubation and initial rearing period (October through February).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the Fish Barrier Dam, below Thermalito Afterbay Outlet, and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Yuba River Fall-run Chinook Salmon	
Mean daily flows (cfs) occurring at the USGS gauge (at Marysville and Smartville) for each month of the year.	Increase in flows, relative to the basis of comparison, of sufficient magnitude and rapidity to attract non-indigenous salmonids into the lower Yuba River.
Mean daily water temperatures (°F) at the USGS gauge (at Marysville and Daguerre Point Dam) for each month of the year.	Decrease in water temperatures, relative to the basis of comparison, of sufficient magnitude and contrast to Feather River water temperatures to attract non-indigenous salmonids into the lower Yuba River.
Lower American River Fall-run Chinook Salmon	
Monthly mean flow (cfs) at the mouth of the American River for each month of the adult immigration period (September through December).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at the mouth of the American River and at Freeport on the Sacramento River for each month of the adult immigration period (September through December).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Nimbus Dam and at Watt Avenue for each month of the spawning, egg incubation, and initial rearing period (October through February).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) below Nimbus Dam and at Watt Avenue for each month of the spawning, egg incubation, and initial rearing period (October through February).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue and the mouth of the American River for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean water temperature (°F) below Nimbus Dam, at Watt Avenue, at the mouth of the lower American River, and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Merced River Fall-run Chinook Salmon	
Monthly mean flow (cfs) below Crocker-Huffman Dam and at the mouth of the Merced River for each month of the adult immigration period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean flows (cfs) below Crocker-Huffman Dam and at the mouth of the Merced River for each month of the spawning and egg incubation period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below Crocker-Huffman Dam and at the mouth of the Merced River for each month of the juvenile rearing and emigration period (January through June).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
San Joaquin River Fall-run Chinook Salmon	
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the adult immigration period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean flows (cfs) below the confluence of the Merced River and at Vernalis for each month of the spawning and egg incubation (October through January).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the juvenile rearing and emigration period (January through June).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Sacramento River Late-fall-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration and holding period (October through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration and holding period (October through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (December through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the spawning, egg incubation, and initial rearing period (December through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (April through October).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon	
Effect Indicators	**Evaluation Criteria**
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (April through October).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Butte Creek Late-fall-run Chinook Salmon	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (late-December through February).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigation for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (April through June).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.2.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of fall-run and late-fall-run Chinook salmon on the Sacramento and lower American rivers. Potential effects on fall-run/late-fall-run Chinook salmon related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on fall-run/late-fall-run Chinook salmon. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Sacramento River and Impacts to Fall-run Chinook Salmon in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower Feather River; Section 9.2.5.1.3, Yuba River Basin, Impacts to Yuba River Fisheries Resources; Section 9.2.5.1.4, American River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower American River; and Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Fall-run Chinook Salmon in the Merced River and Impacts to Fall-run Chinook Salmon and Steelhead in the San Joaquin River, of the EWA EIS/EIR.

For a detailed analysis of potential river flow and water temperature effects on late-fall-run Chinook salmon, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Late-fall-run Chinook Salmon in the Sacramento River and Impacts to Late-fall-run Chinook Salmon in Butte Creek, of the EWA EIS/EIR.

A detailed analysis of potential effects on Chinook salmon within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

4.2.3.1 Fall-run Chinook Salmon

Flow

Flow reductions in the Sacramento, lower Feather, Yuba, lower American, Merced, and San Joaquin Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, spawning, egg incubation, and initial rearing, juvenile rearing, or juvenile emigration. Flow increases in the Sacramento, lower Feather, Yuba, and lower American rivers would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Although flow increases in the Merced and San Joaquin rivers in the fall would beneficially affect adult immigration and the availability of spawning habitat, changes in the flow pattern may raise the potential for redd dewatering. Potential reductions of agricultural return flows in Butte Creek are expected to occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on fall-run Chinook salmon in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento, lower Feather, Yuba, lower American, Merced, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. However, at the mouth of the Feather River, there would be one additional occurrence when mean monthly water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65°F) with the Proposed Action, relative to the basis of comparison. At two locations in the lower American River (below Nimbus Dam and at Watt Avenue) there would be one additional occurrence each during October in which the mean monthly temperatures would be above the upper end of the suitable range of water temperatures for egg incubation (56°F) under the Proposed Action, relative to the basis of comparison.

Annual Early Lifestage Survival

In the Sacramento River, long-term average annual early lifestage survival would be 91.2 percent under the basis of comparison and 91.1 percent with the Proposed Action. Reductions in annual early lifestage survival of 0.1 to 0.7 percent, relative to the basis of comparison, would occur in 11 of 69 years. In 8 of the 11 years, reductions in survival would be 0.1 percent, relative to the basis of comparison, and in 3 years, reductions in survival of 0.2 percent, 0.3 percent, and 0.7 percent would occur. In the lower American River, long-term average annual early lifestage survival would be 90.6 percent under the basis of comparison and 90.5 percent with the Proposed Action. Reductions in annual early lifestage survival of 0.1 to 1.4 percent relative to the basis of comparison would occur in 37 of 69 years simulated, however decreases of greater than 0.5 percent would occur in only five years.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect fall -run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

4.2.3.2 Late-fall-run Chinook Salmon

Flow

Flow reductions in the Sacramento River would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction and holding of immigrating adults, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Flow increases in the Sacramento River would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Potential reductions of agricultural return flows in Butte Creek are expected to occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on late-fall-run Chinook salmon in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento River would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration.

Annual Early Lifestage Survival

No change in long-term average annual early lifestage survival in the Sacramento River would occur with the Proposed Action, relative to the basis of comparison. Substantial increases or decreases in survival would not occur in any individual year of the 69-year simulation, relative to the basis of comparison. In 67 of 69 years, there would be no difference in annual early lifestage survival between the Proposed Action and the basis of comparison. In 2 of the 69 years, a decrease in survival of 0.1 percent and increase in survival of 0.1 percent would occur, relative to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios.

The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect late-fall -run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities
Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Central Valley fall-/late fall-run Chinook salmon.

4.2.4 Conservation Measures

Effects of EWA actions on anadromous fish were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on fall-run/late-fall-run Chinook salmon and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San

Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.
- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at Project facilities or when their habitat may be adversely affected.
- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.
- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.
- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from Project reservoirs to reduce or avoid stranding of juveniles.
- In May, the EWA agencies will evaluate Folsom Reservoir coldwater pool availability to benefit returning adult fall-run Chinook salmon prior to releasing EWA assets.
- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

4.2.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on fall-run/late-fall-run Chinook salmon provided in Section 4.2.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Central Valley fall-run/late-fall-run Chinook salmon.

4.3 Sacramento River Winter-run Chinook Salmon (*Oncorhynchus tshawytscha*)

4.3.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Sacramento River winter-run Chinook salmon occur only in the Sacramento River. Winter-run Chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 243). Winter-run Chinook salmon spawn between late-April and mid-August, with peak spawning generally occurring in June. Winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past Red Bluff Diversion Dam occurring from August through March (Reclamation 1992). Emigration (downstream migration) of winter-run Chinook salmon juveniles past Red Bluff Diversion Dam is believed to peak during September and October (Hallock and Fisher 1985), with abundance of juveniles in the Delta generally peaking during February, March, or April (Stevens 1989). Additional details regarding the status of Sacramento River winter-run Chinook salmon in the EWA Action Area are provided in Section 3.2.2, Sacramento River Winter-run Chinook Salmon

4.3.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-18 presents the effects indicators and evaluation criteria used in the analysis of potential effects on Sacramento River winter-run Chinook salmon.

Table 4-18. Effect Indicators and Evaluation Criteria for Sacramento River Winter-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Sacramento River Winter-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration period (December through July).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration (e.g., resulting flows <3,250 cfs), for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration period (December through July).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.

Table 4-18. Effect Indicators and Evaluation Criteria for Sacramento River Winter-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (April through August).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge and Jelly's Ferry for each month of the spawning, egg incubation, and initial rearing period (April through August).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (August through December).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting flows <3,250 cfs), for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (August through December).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.3.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of winter-run Chinook salmon on the Sacramento River. Potential effects on winter-run Chinook salmon related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on winter-run Chinook salmon. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Winter-run Chinook Salmon in the Sacramento River, of the EWA EIS/EIR.

A detailed analysis of potential effects on Chinook salmon within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Flow reductions on the Sacramento River would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, maintenance of sufficient flows for spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Flow increases would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Flows on the Sacramento River would not be reduced below the NOAA Fisheries Winter-run Chinook Salmon BO flow criterion more frequently with the Proposed Action, relative to the basis of comparison.

Water Temperature

Changes in water temperature in the Sacramento River would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Under the basis of comparison, Sacramento River water temperatures at Bend Bridge exceed the NOAA Fisheries Winter-run Chinook Salmon BO temperature criterion in 32 out of 276 months modeled for the April through July period. In addition, water temperatures remain below the NOAA Fisheries temperature criterion at Bend Bridge and Jelly's Ferry in 339 and 340 months, respectively, of the 345 months modeled for the August through December period, under the basis of comparison. However, Sacramento River water temperatures would not exceed the NOAA Fisheries Winter-run Chinook Salmon BO temperature criterion more frequently with the Proposed Action, relative to the basis of comparison.

Annual Early Lifestage Survival

No change in long-term average annual early lifestage survival in the Sacramento River would occur with implementation of the Proposed Action. There would be a maximum relative reduction of 0.1 percent in annual early lifestage survival in the Sacramento River in 5 of the 69 years simulated.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of

X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect winter-run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Sacramento River winter-run Chinook salmon.

4.3.4 Conservation Measures

Effects of EWA actions on anadromous fish were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on winter-run Chinook salmon and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.

- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

4.3.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on winter-run Chinook salmon provided in Section 4.3.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Sacramento River winter-run Chinook salmon.

4.4 Central Valley Spring-run Chinook Salmon (*Oncorhynchus tshawytscha*)

4.4.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Historically, the Central Valley spring-run Chinook salmon was one of the most abundant and widely distributed salmon races. Extirpations followed construction of major water storage and flood control reservoirs on the Sacramento and San Joaquin Rivers and their major tributaries in the 1940s and 1950s (Moyle *et al.* 1995; 63 FR 11841, March 9, 1998). Spring-run Chinook salmon have been completely extirpated in the San Joaquin drainage. Additional details regarding the status of Central Valley spring-run Chinook salmon in the EWA Action Area are provided in Section 3.2.3, Central Valley Spring-run Chinook Salmon.

4.4.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-19 presents the effect indicators and evaluation criteria used in the analysis of potential effects on Central Valley spring-run Chinook salmon.

Table 4-19. Effect Indicators and Evaluation Criteria for Central Valley Spring-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Sacramento River Spring-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration and holding period (March through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration and holding period (March through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (August through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge and Jelly's Ferry for each month of the spawning, egg incubation, and initial rearing period (August through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.

Table 4-19. Effect Indicators and Evaluation Criteria for Central Valley Spring-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (December through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (December through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Butte Creek Spring-run Chinook Salmon	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (mid-February through July).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigation for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (December through May).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Lower Feather River Spring-run Chinook Salmon	
Monthly mean flow (cfs) at the mouth of the Feather River and below the Thermalito Afterbay for each month of the adult immigration and holding period (March through August).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at the mouth of the Feather River, below the Thermalito Afterbay Outlet, and in the Low Flow Channel below the Fish Barrier Dam for each month of the adult immigration and holding period (March through August).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below the Thermalito Afterbay Outlet for each month of the spawning and egg incubation period (August through November.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) below the Fish Barrier Dam and the Thermalito Afterbay Outlet for each month of the spawning and egg incubation period (August through November.	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (November through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) in the Low Flow Channel below the Fish Barrier Dam, below Thermalito Afterbay Outlet, and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (November through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.

Table 4-19. Effect Indicators and Evaluation Criteria for Central Valley Spring-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Yuba River Spring-run Chinook Salmon	
Mean daily flows (cfs) occurring at the USGS gauge (at Marysville and Smartville) for each month of the year.	Increase in flows, relative to the basis of comparison, of sufficient magnitude and rapidity to attract non-indigenous salmonids into the lower Yuba River.
Mean daily water temperatures (°F) at the USGS gauge (at Marysville and Daguerre Point Dam) for each month of the year.	Decrease in water temperatures, relative to the basis of comparison, of sufficient magnitude and contrast to Feather River water temperatures to attract non-indigenous salmonids into the lower Yuba River.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.4.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of spring-run Chinook salmon on the Sacramento River. Potential effects on spring-run Chinook salmon related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on Central Valley spring-run Chinook salmon. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Spring-run Chinook Salmon in the Sacramento River and Impacts to Spring-run Chinook Salmon in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Spring-run Chinook Salmon in the Feather River; and Section 9.2.5.1.3, Yuba River Basin, Impacts to Yuba River Fisheries Resources, of the EWA EIS/EIR.

A detailed analysis of potential effects on Chinook salmon within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Flow reductions in the Sacramento, lower Feather, and lower Yuba Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction and holding of immigrating adults, spawning, egg incubation, and initial rearing, and juvenile rearing or emigration. Flow increases would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Potential reductions of agricultural return flows in Butte Creek are expected to occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on spring-run Chinook salmon in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento, lower Feather, and lower Yuba Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. However, with the Proposed Action, there would be one additional occurrence at the mouth of the Feather River in which monthly mean water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65ºF), relative to the basis of comparison.

Annual Early Lifestage Survival

Long-term average annual early lifestage survival in the Sacramento River would be 87.5 percent under the basis of comparison and 87.4 percent with the Proposed Action. In 56 out of 69 years, there would be no difference in annual early lifestage survival between the Proposed Action and the basis of comparison. In 3 of 69 years, relative decreases in survival would range from 0.2 to 1.5 percent, relative to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect spring-run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Central Valley spring-run Chinook salmon.

4.4.4 Conservation Measures

Effects of EWA actions on anadromous fish were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on spring-run Chinook salmon and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the

Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.

- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

4.4.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on spring-run Chinook salmon provided in Section 4.4.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Central Valley spring-run Chinook salmon.

4.5 Central Valley Steelhead (*Oncorhynchus mykiss*)

4.5.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Historically, the Central Valley ESU steelhead was well distributed throughout the Sacramento and San Joaquin river systems: from the upper Sacramento/Pit river systems south to the Kings and possibly Kern River systems in wet years (Yoshiyama *et al*. 1996). Currently, steelhead distribution is primarily limited by dams that block access to upstream reaches of main rivers and their tributary streams. The existing Central Valley steelhead ESU includes steelhead in all river reaches accessible to the Sacramento and San Joaquin Rivers and their tributaries in California (Federal Register 2000). Additional details regarding the status of Central Valley steelhead in the EWA Action Area are provided in Section 3.2.4, Central Valley Steelhead.

4.5.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-20 presents the effect indicators and evaluation criteria used in the analysis of potential effects on Central Valley steelhead.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Sacramento River Central Valley Steelhead	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration period (September through March).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and at Freeport for each month of the adult immigration period (September through March).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the spawning and egg incubation period (December through March),	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport in the Sacramento River for each month of the spawning and egg incubation period (December through March),	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F) for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile over-summer rearing period not covered in the fall-run Chinook salmon juvenile rearing analysis (July through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead	
Effects Indicators	**Evaluation Criteria**
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile over-summer rearing period not covered in the fall-run Chinook salmon juvenile rearing analysis (July through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile fall/winter rearing period (October through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile fall/winter rearing period (October through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for a given month of this period over the 72-year period of record.
Monthly water mean temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival, based on LSALMON2 output for late-fall-run Chinook salmon.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect long-term initial year-class strength over the 72-year period of record.
Butte Creek Central Valley Steelhead	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (late-fall through winter).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigration for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile rearing period (year-round).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile rearing for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (September through June).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Lower Feather River Central Valley Steelhead	
Monthly mean flow (cfs) below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the adult immigration period (September through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the adult immigration period (September through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet for the spawning and egg incubation period (December through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead	
Effects Indicators	**Evaluation Criteria**
Monthly mean water temperature (°F) below the Fish Barrier Dam, and below Thermalito Afterbay for each month of the spawning and egg incubation period (December through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet and at the mouth of the Feather River for the juvenile over-summer rearing period (July through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the Fish Barrier Dam, below Thermalito Afterbay, and at the mouth of the Feather River for each month of the juvenile over-summer rearing period (July through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet and at the mouth of the Feather River for the juvenile fall/winter rearing period (October through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the Fish Barrier Dam, below Thermalito Afterbay, and at the mouth of the Feather River for each month of the juvenile fall/winter rearing period (October through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration, for a given month of this period over the 72-year period of record.
Monthly water mean temperature (°F) below Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F), for a given month of this period over the 69-year period of record.
Yuba River Central Valley Steelhead	
Mean daily flows (cfs) occurring at the USGS gauge (at Marysville and Smartville) for each month of the year.	Increase in flows, relative to the basis of comparison, of sufficient magnitude and rapidity to attract non-indigenous salmonids into the lower Yuba River.
Mean daily water temperatures (°F) at the USGS gauge (at Marysville and Daguerre Point Dam) for each month of the year.	Decrease in water temperatures, relative to the basis of comparison, of sufficient magnitude and contrast to Feather River water temperatures to attract non-indigenous salmonids into the lower Yuba River.
Lower American River Central Valley Steelhead	
Monthly mean flow (cfs) at the mouth of the American River for each month of the adult immigration period (December through March).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at the mouth of the American River and at Freeport on the Sacramento River for each month of the adult immigration period (December through March).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Nimbus Dam and at Watt Avenue for each month of the spawning and egg incubation period (December through April.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the spawning and egg incubation period (December through April.	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue for each month of the juvenile over-summer rearing period (July through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the juvenile over-summer rearing period (July through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue for the juvenile fall/winter rearing period (October through January)	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the juvenile fall/winter rearing period (October through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue, the mouth of the American River and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for a given month of this period over the 72-year period of record.
Monthly water mean temperature (°F) at Watt Avenue, at the mouth of the American River, and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
San Joaquin River Central Valley Steelhead	
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the adult immigration period (November through January).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the spawning and egg incubation period (November through January).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the juvenile over-summer rearing period (July through September).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis during the juvenile fall/winter rearing period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the juvenile emigration period (November through May).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for a given month of this period over the 72-year period of record.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.5.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of steelhead on the Sacramento River. Potential effects on steelhead related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on Central Valley steelhead. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Sacramento River and Impacts to Steelhead in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower Feather River; Section 9.2.5.1.3, Yuba River Basin, Impacts to Yuba River Fisheries Resources; Section 9.2.5.1.4, American River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower American River; and Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the San Joaquin River, of the EWA EIS/EIR.

A detailed analysis of potential effects on steelhead within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Flow reductions in the Sacramento, lower Feather, Yuba, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, spawning, egg incubation, and initial rearing, juvenile over-summer and fall/winter rearing, or juvenile emigration.

Flow increases would not be of sufficient magnitude to beneficially affect attraction of immigrating adults or downstream passage of emigrating juveniles. Potential reductions of agricultural return flows in Butte Creek would occur outside the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on steelhead in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento, lower Feather, Yuba, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for spawning, incubation, and initial rearing, or juvenile rearing and emigration. However, at the mouth of the Feather River, there would be one additional occurrence when mean monthly water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65ºF) with the Proposed Action, relative to the basis of comparison. In addition, in October there would be one additional occurrence in the lower American River below Nimbus Dam and one additional occurrence in the lower American River at Watt Avenue in which water temperatures would be above the upper end of the suitable range of temperature for egg incubation (56ºF), relative to the basis of comparison.

Annual Early Lifestage Survival

Based on the late-fall run Chinook salmon survival analysis for the Sacramento River, there would be no change in long-term average annual early lifestage survival in the Sacramento River with the Proposed Action, relative to the basis of comparison. Substantial increases or decreases in survival would not occur in any individual year of the 69-year simulation. In 67 of 69 years, there would be no difference in annual early lifestage survival between the Proposed Action and the basis of comparison. In 2 of the 69 years, there would be a decrease in survival of 0.1 percent and an increase in survival of 0.1 percent, relative to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect steelhead in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual steelhead salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 28,928 steelhead, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 20,386 steelhead, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in steelhead salvage in July under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to substantially alter steelhead salvage patterns in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect steelhead.

4.5.4 Conservation Measures

Effects of EWA actions on steelhead were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on Central Valley steelhead and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.
- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.
- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.
- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.
- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.
- In May, the EWA agencies will evaluate Folsom Reservoir coldwater pool availability to benefit over-summering juvenile steelhead prior to releasing EWA assets.
- The EWA agencies will consult with the local river management teams regarding flow ramping rates before and after EWA transfers to avoid downstream movement of juvenile steelhead.

4.5.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on steelhead provided in Section 4.5.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Central Valley steelhead.

4.6 Delta Smelt (*Hypomesus transpacificus*)

4.6.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Delta smelt are found mainly in the waters of the Delta and Suisun Bay, but are generally most abundant in the western Delta and eastern Suisun Bay (Honker Bay) and commonly use Montezuma Slough. Their spawning distribution varies from year to year within the Delta. The species is endemic to the Sacramento-San Joaquin estuary and its population abundance varies substantially from year to year. Abundance has been uncharacteristically low since 1982, in large part because of the extended drought of 1987-1992 and possibly to extremely wet years in 1983 and 1986 (Moyle *et al.* 1989). Population abundance has fluctuated recently from increases in some years to uncharacteristic decreases in other years (Interagency Ecological Program 1998). Additional details regarding the status of delta smelt in the EWA Action Area are provided in Section 3.2.5, Delta Smelt.

4.6.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-21 presents the effect indicators and evaluation criteria used in the analysis of potential effects on delta smelt.

Table 4-21. Effect Indicators and Evaluation Criteria for Delta Smelt

Effect Indicator	Evaluation Criteria
San Joaquin River	
Monthly mean flow (cfs) at Vernalis for each month of the spawning period (January through June).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual delta smelt CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of delta smelt captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.6.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action. Potential effects on delta smelt related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on delta smelt. For a detailed analysis of potential river flow and temperature related effects, refer to Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Delta Smelt in the San Joaquin River, of the EWA EIS/EIR.

A detailed analysis of potential effects on delta smelt within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Changes in San Joaquin River flows are not expected during the spawning period with the Proposed Action, relative to the basis of comparison, therefore beneficial or adverse affects on delta smelt spawning and initial rearing are not anticipated.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to the transport of planktonic larvae.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect delta smelt in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in 14 of the 15 years simulated under the Maximum Water Purchase Scenario, with an overall estimated decrease of 135,887 delta smelt. Under the Typical Water Purchase Scenario, annual salvage estimates exhibit a decrease in all 15 years, with an overall estimated decrease of 93,690 delta smelt. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in delta smelt salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Overall, based on modeling output and the efficiency of real-time adjustment of operations (real-time implementation of conservation measures) in response to abundance and distribution monitoring, implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario may affect but is not likely to adversely affect delta smelt salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Delta smelt.

4.6.4 Conservation Measures

The following conservation measures are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action) and would ensure that potential adverse effects on delta smelt are avoided or minimized:

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The Project Agencies will not initiate EWA water exports in July until EWA Management Agencies agree that delta smelt will not be harmed.

4.6.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on delta smelt provided in Section 4.6.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of delta smelt.

4.7 Sacramento Splittail (*Pogonichthys macrolepidotus*)

4.7.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Endemic to Central Valley lakes and rivers, adult splittail now primarily inhabit the Delta and Suisun Bay and Marsh (Moyle *et al.* 1995). The species' distribution has been reduced to less than one-third of its original range (59 FR 862, January 6, 1994). Fish surveys in the Sacramento-San Joaquin estuary indicate that splittail abundance there had declined by over 50% from 1980 through 1994, most likely in response to the drought of 1987-1992 (Meng and Moyle 1995, Sommer *et al.* 1997). In 1995, abundance reached a record high, relative to historical conditions (Sommer *et al.* 1997). Strong year classes follow high flow years (1995), when portions of the estuary and river floodplains are flooded in winter and early spring. Preliminary surveys in 1998 indicated high larvae and juvenile abundance during this very wet year (California Department of Fish and Game 1998). Additional details regarding the status of Sacramento splittail in the EWA Action Area are provided in Section 3.2.6, Sacramento Splittail.

4.7.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-22 presents the effect indicators and evaluation criteria used in the analysis of potential effects on Sacramento splittail.

Table 4-22. Effect Indicators and Evaluation Criteria for Sacramento Splittail

Effects Indicators	Evaluation Criteria
Sacramento River Splittail	
Monthly mean flows (cfs) at Freeport and below Keswick during each month of the February through May spawning period.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Freeport, Bend Bridge, Jelly's Ferry, and the mouth during each month of the February through May spawning period.	Substantial increase in the frequency, relative to the basis of comparison, in which monthly mean water temperatures exceed the reported upper temperature range for splittail spawning (68°F) for a given month of this period over the 69-year period of record.
Butte Creek Sacramento Splittail	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the spawning period (February through April).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect spawning habitat availability for a given month of this period.
Lower Feather River Sacramento Splittail	
Monthly mean flows (cfs) at the mouth of the Feather River for each month of the February through May spawning period.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at the mouth of the Feather River for each month of the February through May spawning period.	Substantial increase in the frequency, relative to the basis of comparison, in which monthly mean water temperatures exceed the reported upper temperature range for splittail spawning (68°F) for a given month of this period over the 69-year period of record.
Lower American River Sacramento Splittail	
Monthly mean acreage of flooded riparian habitat at Watt Avenue during each month of the February through May spawning period.	Decrease in monthly mean quantity of inundated riparian habitat, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Watt Avenue and the mouth of the lower American River during each month of the February through May spawning period.	Substantial increase in the frequency, relative to the basis of comparison, in which monthly mean water temperatures exceed the reported upper temperature range for splittail spawning (68°F) for a given month of this period over the 69-year period of record.
San Joaquin River Sacramento Splittail	
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the spawning period (February through May).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.

Table 4-22. Effect Indicators and Evaluation Criteria for Sacramento Splittail

Effects Indicators	Evaluation Criteria
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual splittail CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of splittail captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.7.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action. Potential effects on Sacramento splittail related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on Sacramento splittail. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Sacramento Splittail in the Sacramento River and Impacts to Sacramento Splittail in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Sacramento Splittail in the Feather River; Section 9.2.5.1.4, American River Basin, Impacts to Sacramento Splittail in the lower American River; and Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Sacramento Splittail in the San Joaquin River, of the EWA EIS/EIR.

A detailed analysis of potential effects on Sacramento splittail within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Changes in flows on the Sacramento, lower Feather, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to adversely affect the availability of inundated habitat for spawning. Potential reductions of agricultural return flows in Butte Creek are expected to occur after the cessation of splittail spawning, therefore neither beneficial nor adverse effects on splittail spawning in Butte Creek are anticipated.

Water Temperature

Changes in water temperature on the Sacramento, lower Feather, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for spawning (68ºF). However, there would be one additional occurrence of temperatures above the preferred spawning temperature at the mouth of the Feather River with the Proposed Action, compared to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to the transport of planktonic larvae.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect splittail in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in 14 of the 15 years simulated under the Maximum Water Purchase Scenario, with an overall estimated decrease of 1,014,290 splittail. Under the Typical Water Purchase Scenario, annual salvage estimates exhibit a decrease in all 15 years, with an overall estimated decrease of 656,597 splittail. Although annual salvage estimates decrease in all but one year, there would be isolated occurrences of monthly increases in delta smelt salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios.

Although there would be increases in splittail salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario in one year and in individual months of the simulation, such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect splittail salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Sacramento splittail.

4.7.4 Conservation Measures

Effects of EWA actions on Sacramento splittail were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death. The following conservation measures are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action) and would ensure that potential adverse effects on Sacramento splittail are avoided or minimized:

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

4.7.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on splittail provided in Section 4.7.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Sacramento splittail.

4.8 Green Sturgeon (*Acipenser medirostris*)

4.8.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Green sturgeon is an anadromous species, migrating from the ocean to freshwater to spawn. Adults of this species tend to be more marine-oriented than the more common white sturgeon. Nevertheless, spawning populations have been identified in the Sacramento River (Beak Consultants 1993), and most spawning is believed to occur in the upper reaches of the Sacramento River as far north as Red Bluff (Moyle *et al.* 1992; 1995). Adults begin their inland migration in late-February (Moyle *et al.* 1995), and enter the Sacramento River between February and late-July (CDFG 2001). Spawning activities occur from March through July, with peak activity believed to occur between April and June (Moyle *et al.* 1995). In the Sacramento River, green sturgeon presumably spawn at temperatures ranging from 46°F to 57°F (Beak Consultants 1993). Small numbers of juvenile green sturgeon have been captured and identified each year from 1993 through 1996 in the Sacramento River at the Hamilton City Pumping Plant (RM 206) (Brown, pers. comm. 1996). Lower American River (Gerstung 1977) fish surveys conducted by the CDFG have not collected green sturgeon (Snider, pers. comm. 1997). Although a green sturgeon sport fishery exists on the lower Feather River, the extent to which green sturgeon use of the Feather River is still to be determined. Green sturgeon larvae are occasionally captured in salmon outmigrant traps, suggesting the lower Feather River may be a spawning area (Moyle 2002). However, NOAA Fisheries (2002) reports that green sturgeon spawning in the Feather River is unsubstantiated. Additional details regarding the status of green sturgeon in the EWA Action Area are provided in Section 3.2.7, Green Sturgeon.

4.8.2 Effect Assessment Methods

There is not sufficient information available regarding green sturgeon to develop rigorous effect indicators and evaluation criteria similar to those developed for the other special-status species included in this ASIP. Therefore, because several of the life history requirements (e.g., spawning temperature ranges) for green sturgeon are similar to or less stringent than the physiochemical and biological requirements of Chinook salmon, the life history and species criteria (water temperature and flow) used for Chinook salmon is thought to be more conservative and will apply to the analysis for green sturgeon.

4.8.3 Project Effects

As discussed above in Section 4.8.2, Effect Assessment Methods, the analysis of potential effects on Chinook salmon is considered a conservative estimate of potential effects on green sturgeon. The analysis of potential effects on Chinook salmon with implementation of the Proposed Action is provided in Sections 4.2.3, 4.3.3, and 4.4.3, Project Effects.

EWA actions may affect, but are not likely to adversely affect green sturgeon.

4.8.4 Conservation Measures

Riverine conditions (water temperature) suitable for the various life history stages of Chinook salmon are also suitable for green sturgeon, thus conservation measures targeting Chinook salmon are anticipated to also benefit green sturgeon.

4.8.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on Chinook salmon provided in Sections 4.2.3, 4.3.3, and 4.4.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) may contribute to the recovery of green sturgeon.

4.9 Aleutian Canada Goose (*Branta canadensis leucopareia*)

4.9.1 Status in the Action Area

The Aleutian Canada goose was removed from the list of threatened species under the Endangered Species Act on March 20, 2001, but this species is still considered as a Federal Species of Concern for five years after delisting (CDFG 2003). This goose is also 1) protected under the Migratory Bird Treaty Act and Convention on International Trade in Endangered Species of Wild Fauna and Flora (U.S. Fish and Wildlife Service 2001), 2) considered a California Special Animal (CDFG 2003), and 3) listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

The present population of Aleutian Canada geese migrates along the northern California coast and winters in the Central Valley near Colusa and on scattered feeding and roosting sites along the San Joaquin River from Modesto to Los Banos (Jones & Stokes Associates and CH2M Hill 1986, Nelson et al. 1984). Fall migration usually begins in late August or early September, with birds arriving in the Central

Valley between October and early November (U.S. Fish and Wildlife Service 1980). Spring migration usually begins in mid-February and continues to early March (U.S. Fish and Wildlife Service 1980). The current population estimate is approximately 24,000 individuals (63 FR 68:17,350-17,352). Figure 3-1 depicts the distribution of Aleutian Canada geese in California over the winter. According to the Final Rule delisting the goose, the lands used by Aleutian Canada geese during the fall/winter period near Colusa, California, are primarily privately owned farms and Reclamation District land, as well as the Butte Sink National Wildlife Refuge (66 FR 54: 15,643-15656). The goose also overwinters near Cresent City and in the northern San Joaquin Valley.

Most Aleutian Canada geese that nest in the islands winter in California, primarily on agricultural lands. They arrive on the wintering grounds in mid-October (USFWS, 1999). Aleutian Canada geese forage in harvested cornfields, newly planted or grazed pastures, or other agricultural fields (e.g., rice stubble and green barley). Lakes, reservoirs, ponds, and flooded fields are used for roosting and loafing (Grinnell and Miller 1944, U.S. Fish and Wildlife Service 1982). They also roost in large marshes and stock ponds.

Aleutian Canada geese are omnivores, having a steady diet of arthropods, evergreen shrubs, roots, tubers, leaves, and stems during the breeding season. They also consume crowberries. The goslings are fed insects such as ground beetles. All their water is taken from vegetation. During the non-breeding season they feed on crops such as rice, corn, wheat, barley, oats, and lima beans. Water is taken from low-lying flooded areas.

4.9.2 Effect Assessment Methods

The only habitat used by the Aleutian Canada goose affected by EWA actions (crop idling) is seasonally flooded agriculture. (For the EWA program seasonally flooded agriculture is equated with rice.) The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the Aleutian Canada Goose. Table 4-23 provides the relationship of the Aleutian Canada goose with rice lands and the rice production cycle. The primary concern is the loss of wastegrain forage for the goose.

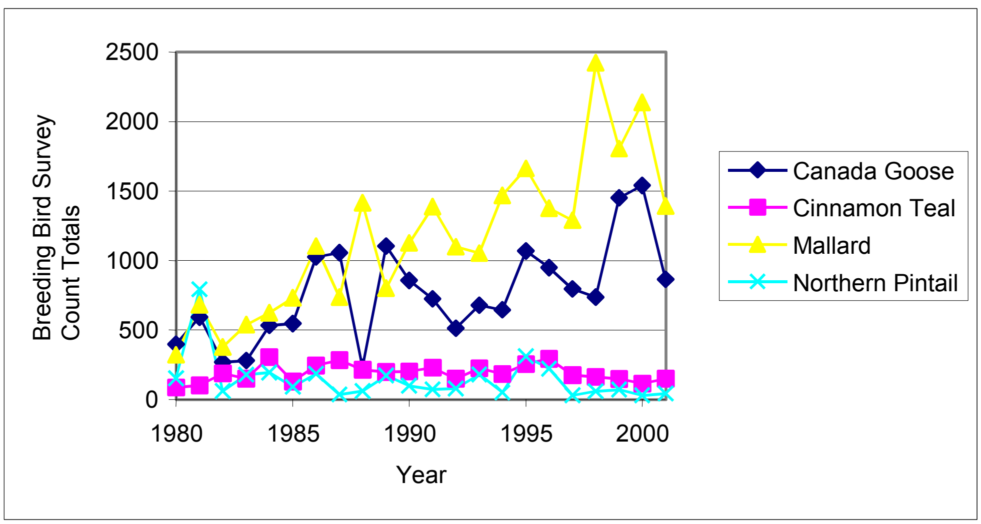
4.9.3 Project Effects

Aleutian Canada Goose Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing winter forage and habitat for this recovering species. The Aleutian Canada goose is a winter visitor to the Central Valley. The primary cause of its population decline was the introduction of foxes to its breeding islands in Alaska. A recovery plan (USFWS 1991a) has been put in place to address the threat predators pose to its breeding habitat. The concern for its winter use in California is to ensure the survival of the over wintering populations as measure of addressing the species overall recovery.

Like many migratory waterfowl, the Aleutian Canada goose forages on waste grain on agricultural fields in the Colusa Basin. This includes flooded rice land and rice land stubble. In addition to waste grains, the birds also consume insects and vegetative matter.

The concern for SFA idling is a reduced winter food supply for the Aleutian Canada goose (31 million pounds out of 157 million pounds within the 6 counties altogether or 20%). However, the analysis of waterfowl population trends for the Central Valley (Figure 4-1) shows no correlation between the amount of waste grain and waterfowl numbers. It appears that waste grain is not a limiting factor for controlling waterfowl populations and therefore the reductions of winter forage resulting from EWA crop idling would have a less-than-significant effect on the species. No environmental measure for the Aleutian Canada goose related to reduction in winter forage is proposed.

Crop idling actions taken by EWA agencies may affect but are not likely to adversely affect the goose.



Source: Sauer, J. R., et. al..

Figure 4-1
Breeding Bird Survey Results 1980-2001

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Giant Garter Snake	Snakes are dormant.	Snakes are dormant.	Snakes emerge. Riceland provides canals with emergent vegetation for cover and for locating mates.	Snakes emerge. Riceland provides canals with emergent vegetation for cover and for locating mates.	Snakes remain close to their denning areas.	Snakes move throughout flooded rice land habitat. Rice land provides warm shallow open waters with aquatic prey for foraging.	Snakes move throughout flooded rice land habitat and start birthing. Rice land provides emergent vegetation for birthing and juvenile dispersion cover.	Snakes move throughout flooded rice land habitat and continue birthing. Rice land provides emergent vegetation for birthing and juvenile dispersion cover.	Snakes complete birthing and leave rice land area to concentrate in drainage ditches and irrigation canals. Rice land provides concentrated prey within canals	Snakes are concentrating in drainage ditches and irrigation canals. Rice land provides drainage pools of concentrated prey for pre-dormancy gorging.	Snakes are dormant.	Snakes are dormant.
Tricolored Blackbird	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.	Birds initiate breeding in habitats adjacent to rice lands. Some foraging may continue in residual flooded fields/inactive fields on aquatic insects and waste grain.	Birds are breeding in habitats adjacent to rice lands. Rice lands in planting stage typically provide no significant resource.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds finish breeding and are dispersing to a variety of habitats. Waste grain becomes available for foraging.	Birds finish breeding and are dispersing to a variety of habitats. Waste grain becomes available for foraging.	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Greater Sandhill Crane	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging/cranes avoid flooded fields.	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging.	Crane migrates to breeding habitat in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane begins returning to winter habitat, typically to the same location each year.	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging.	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging.
Great and Snowy Egrets and Heron	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice lands during planting typically provide no significant resource.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice lands during harvesting typically provide no significant resource.	Egrets are wintering. Rice lands during harvesting typically provide no significant resource.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
White-faced Ibis	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migrating. Rice lands during harvesting typically provide no significant resource.	Ibis is wintering. Rice lands during harvesting typically provide no significant resource.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.
Long-billed Curlew	Curlew is wintering. Rice land resources for the curlew include shallow open waters for foraging on invertebrates.	Curlew is wintering. Rice land resources for the curlew include shallow open waters for foraging on invertebrates.	Curlew is wintering. Rice land resources for the curlew include shallow open waters for foraging on invertebrates.	Curlew moves to breeding areas with elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew returns. Rice lands during harvesting typically provide no significant resource.	Curlew is wintering. Rice land resources include shallow open waters for foraging on invertebrates.	Curlew is wintering. Rice land resources include shallow open waters for foraging on invertebrates.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Black Tern	Tern over winters in South America	Tern over winters in South America	Tern over winters in South America	Terns begin to return to California and initiate breeding in habitats other than rice land. Rice land during planting typically provides no significant resource.	Tern is breeding and can start using flooded rice land for foraging on insects and invertebrates.	Tern is breeding and is using flooded rice land emergent vegetation for nesting and for foraging on insects and invertebrates.	Tern is breeding and is using flooded rice land emergent vegetation for nesting and for foraging on insects and invertebrates.	Tern ends breeding. Rice land resources include shallow open waters and emergent vegetation for foraging on insects and invertebrates.	Terns begin to disperse from riceland	Tern migrates to South America	Tern over winters in South America	Tern over winters in South America
Black-crowned Night Heron	Heron is wintering. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Herons initiate breeding in trees possibly near rice land. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Heron is breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Heron is breeding. Rice lands during planting typically provide no significant resource.	Heron is breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron is breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron completes breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron is roosting in trees more remote from rice land. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron is roosting. Rice lands during harvesting typically provide no significant resource to Herons	Heron is roosting. Rice lands during harvesting typically provide no significant resource to Herons	Heron is wintering. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Heron is wintering. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Western Pond Turtle	Turtles are dormant.	Turtles are dormant.	Turtles become active. Rice land resources include emergent vegetation in canals and drainage ditches for cover and for foraging on aquatic plants and invertebrates and dikes for basking.	Turtles are active. Rice land resources include emergent vegetation in canals and drainage ditches for cover and for foraging on aquatic plants and invertebrates and dikes for basking.	Female turtles begin moving to upland nest sites. Rice land resources include emergent and wet irrigation canals and drainage ditches for cover and for foraging on aquatic plants and invertebrates and dikes for basking.	Female turtles move to upland nest sites. Rice land resources include emergent vegetation in canals and fields for cover and for foraging and dikes for basking.	Female turtles complete nesting. Rice land resources include emergent vegetation in canals and fields for cover and for foraging and dikes for basking.	Turtles are active in fields and canals. Juveniles begin to hatch but remain at the nests, usually until March	Turtles are active. Turtles move into drainages and canals with emergent vegetation and cover and for foraging on aquatic plants and invertebrates.	Turtles are active. Remain in drainages and canals with emergent vegetation until hibernation. Canals have concentrated prey to prepare for hibernation.	Turtles are dormant.	Turtles are dormant.

* The determination of when field preparation initiates is dependent on the last significant rainfall. If rainfall ends in March, field prep can start in April, if rain extends into May, field preparation may wait until early June.

4.9.4 Conservation Measures

Conservation measures are not proposed for the Aleutian Canada goose because this species is not likely to be adversely affected.

4.9.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. These goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The Aleutian Canada goose has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measure listed above will further ensure the potential for effects discussed in Section 4.9.3 are avoided.

4.10 Black Tern (*Chlidonias niger*)

4.10.1 Status in the Action Area

The black tern is listed as a California Species of Special Concern (CDFG 2002) and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

The black tern was a common and even abundant summer breeder and migrant throughout much of California (Grinnell and Miller 1944). The species has declined and now breeds only in the northeast (Siskiyou, Modoc, and Lassen Counties) and Central Valley, although in much-reduced numbers (Zeiner et al. 1990). The black tern requires freshwater habitats for breeding grounds. Nesting sites are found on lakes, ponds, marshes, and agricultural fields (Grinnell and Miller 1944). During migration, this species can be common on coastal bays, river mouths, and well offshore over pelagic waters (Cogswell 1977). Nests are built on floating mats of dead vegetation among anchored vegetation or along the shore where they are built by scraping out the soil (Zeiner et al. 1990). Figure 3-2 depicts the current nesting distribution of the black tern in California.

The black tern forages by hovering above wet meadows and fresh emergent wetlands; catching insects in the air or plucking them from water and vegetation surfaces. It eats grasshoppers, dragonflies, moths, flies, beetles, crickets, and other insects (Terres 1980). It also hovers above croplands, then drops to capture adult and larval insects from recently plowed soil. Another foraging technique is plunging to water surface for tadpoles, crayfish, small fish, and small mollusks. Young are fed insects (Cuthbert 1954). Adults drink during bathing or swoop to water to dip bill several times, particularly after swallowing prey (Dunn and Argo 1995).

4.10.2 Effect Assessment Methods

The only habitat used by the black tern affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the black tern. Table 4-23provides the relationship of the black tern with rice lands and the rice production cycle. The primary concern is the loss of nesting and foraging habitat when rice crops are idled.

4.10.3 Project Effects

Black Tern Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing breeding habitat and summer habitat for this Covered Species. The black tern was once a common spring and summer visitor to the emergent wetlands of the Central Valley, but its numbers have declined due to habitat losses. Although restricted to freshwater habitats for breeding, it migrates to bays, rivers, and pelagic waters the remainder of the year. SFA habitat has partially replaced the lost emergent vegetation breeding habitat for this species. The rice production cycle coincides with the tern's seasonal behavior in two ways: 1) fields are flooded during the tern's Central Valley breeding season, and 2) fields are dry when the birds have migrated to other aquatic habitats.

The black tern forages by hovering above wet meadows and emergent wetlands, catching insects in the air and diving into the water to capture tadpoles, crayfish, small fish, and mollusks. It nests in loose mats of dead vegetation on the ground or anchored to other vegetation. In rice fields, the tern can also nest on dikes that separate the fields.

Because this species uses SFA for nesting and forage, a reduction of rice habitat could be detrimental to local populations. As an environmental measure, idling of rice habitat known to support colonies of black terns should be avoided. The EWA agencies will review maps of areas proposed for EWA water acquisition crop idling for the presence of the nearest colony. Fields supporting colonies will not be idled.

Crop idling actions may affect but are likely to adversely affect black tern populations with the implementation of the following conservation measures.

4.10.4 Conservation Measures

Crop idling of seasonally flooded agricultural land could reduce the amount of nesting and forage habitat during the summer rearing season.

- As part of the review process for the identification of areas acceptable for crop idling, the Management Agencies will review current species distribution/occurrence information from the Natural Diversity Database and other sources (including rookeries, breeding colonies, and concentration areas). The Management Agencies will then use the information to make decisions that will avoid EWA crop idling actions that could result in the substantial loss or degradation of suitable habitat in areas that support core populations of evaluated species that are essential to maintaining the viability and distribution of evaluated species.

- As part of contractual agreements, the willing seller will be required to maintain quantities of water in agriculture return flow ditches that maintains existing wetland habitat providing habitat to the covered species.

4.10.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into CALFED, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The black tern has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measure listed above will further ensure the potential for effects discussed in Section 4.10.3 are avoided or minimized.

4.11 Black-crowned Night Heron (*Nycticorax nycticorax*)

4.11.1 Status in the Action Area

The black-crowned night heron is listed as a U.S. Bureau of Land Management sensitive species (CDFG 2003). This heron is not a federally listed species, nor is it a California listed species or species of special concern.

The black-crowned night heron is a fairly common yearlong resident of the foothills and lowlands throughout most of California. Figure 3-3 depicts the distribution of black-crowned night heron rookeries. The heron roosts during the day in dense trees or dense emergent wetland plants. The black-crowned night heron feeds primarily at night. Foraging is conducted largely along the margins of lacustrine, riverine, and fresh and saline emergent wetlands. The highly variable diet consists of fishes, crustaceans, aquatic insects, other vertebrates, amphibians, reptiles, some small mammals, and rarely a young bird. These birds hunt in shallow water waiting motionlessly, but just as often they stalk their prey (CDFG 1995).

4.11.2 Effect Assessment Methods

The only habitat used by the black-crowned night heron affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the black-crowned night heron. Table 4-23 provides the relationship of the black-crowned night heron with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat such as irrigation canals near rookery areas when rice crops are idled.

4.11.3 Project Effects

Black-Crowned Night Heron Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for this Covered Species. The black-crowned night heron is a fairly common, yearlong resident of lowlands and foothills in California. It nests and roosts in dense tree foliage. Nesting roosts are typically near water, but non-breeding roosts can be some distance from water. Unlike other herons, the black-crowned night heron feeds primarily at night. It has a highly variable diet consisting of fish, crustaceans, aquatic insects, and other invertebrates, amphibians, and small mammals. There are reports of black-crowned night herons raiding bird colonies, including terns and tricolored black birds.

SFA habitat is just one of the many habitats used by the black-crowned night heron. These birds commonly fly up to three miles from their roosts to their feeding areas. Although idling of rice fields may reduce some forage available to the heron, the heron has no particular affinity to this habitat. The only effect would be to those herons, which have incorporated rice into their foraging routine. If insufficient forage is present within idled rice fields, the black-crowned night heron has the ability to forage elsewhere. The heron's roosting sites are not dependent on rice farmland practices and will not be affected by crop idling actions.

The EWA program may effect but is not likely to adversely affect the black-crowned night heron.

4.11.4 Conservation Measures

Conservation measures are not proposed for the black-crowned night heron because this species is not likely to be adversely affected.

4.11.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The black-crowned night heron has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.11.3.

4.12 Great Blue Heron (*Ardea herodias*)

4.12.1 Status in the Action Area

The great blue heron is listed as a California Department of Forestry sensitive species (CDFG 2003). This heron is not a federally listed species, nor is it a California listed species or species of special concern.

Figure 3-4 depicts the distribution of great blue heron rookeries. Great blue herons use shallow estuary systems and fresh and saline emergent wetlands year round. Tall riparian-type trees are needed for perching and roosting sites (CDFG 1995). Great blue herons forage mostly for fish, but also eat small rodents, amphibians, snakes, lizards, insects, crustaceans, and occasionally small birds. Hunting techniques include standing motionless, wading slowly, probing and pecking, and then grasping prey in bill (CDFG

1995, Granholm 1990). Foraging can occur both night and day, but mostly occurs around dawn and dusk (Granholm 1990).

4.12.2 Effect Assessment Methods

The only habitat used by the great blue heron affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the great blue heron. Table 4-23 provides the relationship of the great blue heron with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.12.3 Project Effects

Great Blue Heron, Great Egret, Snowy Egret Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for these Covered Species. These three species are included in one assessment because of coinciding roosting and feeding habits. In the Central Valley, all three species roost communally in trees in riparian areas, and feed commonly in shallow water, along shorelines, irrigation ditches, and other water bodies that contain fish, amphibians, insects, crustaceans, small mammals, and similar prey items. The species will readily abandon nesting attempts if disturbed. Destruction of riparian habitat and roosting trees is therefore a major concern for all of these species.

These species typically “commute” daily from their overnight roosting sites to their feeding areas. All species typically travel from one to five miles from the roosting site to the feeding locations. For seasonally flooded agricultural land (rice farmland), these species utilize both the rice fields and associated irrigation ditches. In relation to the rice cycle (Section 10.1.1.14), the flooded fields during the summer and the irrigation ditches during the fall provide ample aquatic and insect prey. The dry fields during fall and spring, and partially flooded fields during the winter provide for some insect prey. None of the species rely on waste grain (except for the insect populations the grain may support) and thus absence of waste grain is not a concern for the species as it is for other avian species.

Idling of rice farmland for a season has the potential to reduce some summer and fall forage for egrets and herons that roost within 5 miles of the idling action. Because the birds will travel long distances to forage and because environmental measures for the giant garter snake will provide for the maintenance of aquatic habitat in rice growing areas, the only effect on these species is a potential change in forage patterns from idled fields to fields with abundant prey. Idling of rice farmland will not affect roosting sites; there is less human activity because no farming is occurring. Therefore, effects would be less than significant and no environmental measures are proposed.

The EWA program may affect but is not likely to adversely affect the great blue heron.

4.12.4 Conservation Measures

Conservation measures are not proposed for the great blue heron because this species is not likely to be adversely affected.

4.12.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The great blue heron has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.12.3.

4.13 Great Egret (*Casmerodius albus*)

4.13.1 Status in the Action Area

The great egret is listed as a California Department of Forestry sensitive species (CDFG 2003). This egret is not a federally listed species, nor is it a California species of special concern.

Figure 3-5 depicts the distribution of great egret rookeries. Great egrets use a wide variety of fresh, brackish, and saltwater habitats including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, mudflats, salt ponds, and irrigated croplands and pasture (Granholm 1990). These egrets feed on fishes, amphibians, snakes, snails, crustaceans, insects and small mammals (NatureServe Explorer 2002). This species is a colonial rooster and nester and requires thick riparian stands of large trees near aquatic foraging areas and relatively isolated from human activities (Granholm 1990, CDFG 1995).

4.13.2 Effect Assessment Methods

The only habitat used by the great egret affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the great egret. Table 4-23 provides the relationship of the great egret with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.13.3 Project Effects

Great Blue Heron, Great Egret, Snowy Egret Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for these Covered Species. These three species are included in one assessment because of coinciding roosting and feeding habits. In the Central Valley, all three species roost communally in trees in riparian areas, and feed commonly in shallow water, along shorelines, irrigation ditches, and other water bodies that contain fish, amphibians, insects, crustaceans, small mammals, and similar prey items. The species will readily abandon nesting attempts if disturbed. Destruction of riparian habitat and roosting trees is therefore a major concern for all of these species.

These species typically "commute" daily from their overnight roosting sites to their feeding areas. All species typically travel from one to five miles from the roosting site to the feeding locations. For seasonally flooded agricultural land (rice farmland), these species utilize both the rice fields and associated irrigation ditches. In relation to the rice cycle (Section 10.1.1.14), the flooded fields during the summer and the irrigation ditches during the fall provide ample aquatic and insect prey. The dry fields during fall and spring, and partially flooded fields during the winter provide for some insect prey. None of the species rely on waste grain (except for the insect populations the grain may support) and thus absence of waste grain is not a concern for the species as it is for other avian species.

Idling of rice farmland for a season has the potential to reduce some summer and fall forage for egrets and herons that roost within 5 miles of the idling action. Because the birds will travel long distances to forage and because environmental measures for the giant garter snake will provide for the maintenance of aquatic habitat in rice growing areas, the only effect on these species is a potential change in forage patterns from idled fields to fields with abundant prey. Idling of rice farmland will not affect roosting sites; there is less human activity because no farming is occurring. Therefore, effects would be less than significant and no environmental measures are proposed.

The EWA program may affect but is not likely to adversely affect the great egret.

4.13.4 Conservation Measures

Conservation measures are not proposed for the great egret because this species is not likely to be adversely affected.

4.13.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The great egret has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.13.3.

4.14 Greater Sandhill Crane (*Grus canadensis tabida*)

4.14.1 Status in the Action Area

The greater sandhill crane is listed as threatened under the California Endangered Species Act and is a fully protected species under the California Fish and Game Code

(CDFG 2003). It is also listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

In California the greater sandhill crane breeds in the northeastern portion of the state. Between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and Sacramento-San Joaquin River Delta (Pogson and Lindstedt 1991, California Department of Fish and Game 1997, Pacific Flyway Council 1997). Figure 3-6 depicts the distribution of greater sandhill crane habitat. Greater sandhill crane can be located in the Ash Creek, Shasta Valley, Butte Valley, Gray Lodge, Honey Lake, and Los Banos Wildlife Areas; the Woodbridge Ecological Reserve; the Merced, Modoc, Sacramento, and Tule Lake/Lower Klamath and Pixely National Wildlife Refuges; the Carrizo Plain National Area and Consumnes River Preserve; and other lands adjacent to these areas. Greater sandhill cranes nest in open areas of wet meadows that are often interspersed with emergent marsh and usually build their nests over shallow water. Favorable roost sites and an abundance of cereal grain crops characterize winter concentration areas. Rice is the primary food source for cranes near Gray Lodge WA, Butte County, and corn is the most important food at the majority of other concentration areas in the Central Valley particularly in the Sacramento - San Joaquin delta. Irrigated pastures are used extensively as loafing sites in some wintering areas. Greater sandhill cranes have an omnivorous diet consisting primarily of vegetable matter such as small grains; however, they will consume almost any available food. They feed in pastures, flooded grain fields, and seasonal wetlands. Toads, frogs, eggs, young birds, small rodents, invertebrates, roots, and tubers are all included in their diet. However, animal matter, except for certain invertebrates, is taken primarily opportunistically and should not be considered a major component of the diet of cranes.

4.14.2 Effect Assessment Methods

The only habitat used by the greater sandhill crane affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the crane. Table 4-23 provides the relationship of the greater sandhill crane with rice lands and the rice production cycle. The primary concern is the loss of winter foraging habitat in the Butte Basin when rice crops are idled.

4.14.3 Project Effects

Greater Sandhill Crane Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley thereby reducing winter forage for this Covered Species. The Central Valley Population of the sandhill crane is one of five populations in North America (Littlefield et al. 1994). It is comprised of 6000-6800 individuals, among which 3400 breed in the southern segment of its range, which includes northeast California, outside of the EWA action area. The entire population winters in the Central Valley (Littlefield and Thompson 1979), and from 1983-1984, 95percent wintered from Sacramento Valley south to the Bay-Delta (Pogson and Lindstedt 1991).

The greater sandhill crane uses harvested rice fields in the Sacramento Valley for wintering habitat and forage from October to February (Littlefield 1993). It also uses grain fields in the Delta. The time period that cranes over winter also corresponds to the time when rice land is being harvested (October) and then becomes inactive. The greater sandhill crane prefers rice stubble that has not been flooded to decompose the vegetative materials. Burning or flooding to manage harvested rice stubble has contributed to the reduction of portions of the crane's wintering habitat (Littlefield 1993).

The greater sandhill crane typically returns to the same location each year to winter. Crop idling of seasonally flooded agricultural land used for rice production in the areas to which the cranes return will affect their wintering distribution patterns due to reduced forage on the idled fields. Although the cranes will disperse from their core areas as winter food resources diminish, crop idling could affect this change earlier. Avoiding crop idling in the core areas could minimize this effect to crane populations.

Crop idling actions may affect but are not likely to adversely affect greater sandhill crane populations with implementation of the following conservation measure.

4.14.4 Conservation Measures

Crop idling of seasonally flooded agricultural land could reduce the amount of over winter forage for migratory birds.

- Avoid or minimize actions near known wintering areas in the Butte Sink (from Chico in the north to the Sutter Buttes, and from Sacramento River in the west to Highway 99) that could adversely affect foraging and roosting habitat.

4.14.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The greater sandhill crane has been designated an "r" or "contribute to recovery" species. For this designation, the CALFED agencies will make specific contributions towards the recovery of the species (CALFED MSCS 2000).

4.15 Long-billed Curlew (*Numenius americanus*)

4.15.1 Status in the Action Area

The long-billed curlew is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

The long-billed curlew's California summer breeding populations occur in Siskiyou, Modoc, and Lassen Counties in northeastern California. Non-breeding populations have been found along the coast and in the Central and Imperial Valleys. Figure 3-7 depicts the distribution of long-billed curlew habitat. Preferred breeding habitats are elevated grasslands adjacent to lakes or marshes. Central valley wintering and non-breeding summer populations utilize grassland and cropland habitat. This species normally feeds on various insects (grasshoppers, beetles, caterpillars, etc.) and eats some berries. During migration they also feed on crayfishes, crabs, snails, and toads.

4.15.2 Effect Assessment Methods

The only habitat used by the long-billed curlew affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the curlew.
Table 4-23 provides the relationship of the long-billed curlew with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat when rice crops are idled.

4.15.3 Project Effects

Long-billed Curlew Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing winter forage for this Covered Species. The long-billed curlew is a common winter visitor to the Central Valley where it forages on upland herbaceous plants and croplands. Some non-breeding individuals remain in the Central Valley during the summer. Breeding habitat is located in upland prairie grassland habitat outside of the EWA action area. Winter migrants can arrive as early as June and most leave the valley by April. The primary food prey items of the curlew in the Central Valley are estuarine fish, insects, worms, spiders, crayfish, snails, and small crustaceans. Curlews "display no consistent season-specific food item preferences or limitations" (NRCS 2000). Therefore, during the winter curlews would take advantage of flooded or dry rice fields as long as adequate prey is available. The idling of seasonally flooded agricultural land would reduce some insect forage areas for the species (assuming the idled cropland produces less insects), but curlews would respond by looking for forage in other habitats. This effect is considered less than significant and no environmental measure is proposed for this species.

Therefore, EWA actions may affect but are not likely to adversely affect the long-billed curlew.

4.15.4 Conservation Measures

Conservation measures are not proposed for the long-billed curlew because this species is not likely to be adversely affected.

4.15.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The long-billed curlew has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measure listed above will further avoid or minimize the potential effects discussed in Section 4.15.3.

4.16 Snowy Egret (*Egretta thula*)

4.16.1 Status in the Action Area

The Snowy egret is listed on the United States Bird Conservation Watch List (CDFG 2003). This species is also considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the California Endangered Species Act (CDFG 2003).

In California, this species is considered to be a year-round resident below 1,000 feet elevation in the southern three-fourths of the state (Bousman 2000). It is abundant in the seashore, coastal, interior, and Great Basin areas of the state and less common inland and north of Sonoma County (Bousman 2000). Figure 3-12 depicts the distribution of snowy egret rookeries. Snowy egrets use a wide variety of fresh, brackish, and saltwater habitats including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, irrigation ditches and wet fields (Granholm 1990). Egrets forage for fish, crayfish, amphibians, reptiles, worms, arthropods, small mammals, and snails in shallow water or along shores.

4.16.2 Effect Assessment Methods

The only habitat used by the snowy egret affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the snowy egret. Table 4-23 provides the relationship of the snowy egret with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.16.3 Project Effects

Great Blue Heron, Great Egret, Snowy Egret Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for these Covered Species. These three species are included in one assessment because of coinciding roosting and feeding habits. In the Central Valley, all three species roost communally in trees in riparian areas, and feed commonly in shallow water, along shorelines, irrigation ditches, and other water bodies that contain fish, amphibians, insects, crustaceans, small mammals, and similar prey items. The species will readily abandon nesting attempts if disturbed. Destruction of riparian habitat and roosting trees is therefore a major concern for all of these species.

These species typically "commute" daily from their overnight roosting sites to their feeding areas. All species typically travel from one to five miles from the roosting site to the feeding locations. For seasonally flooded agricultural land (rice farmland), these species utilize both the rice fields and associated irrigation ditches. In relation to the rice cycle (Section 10.1.1.14), the flooded fields during the summer and the irrigation ditches during the fall provide ample aquatic and insect prey. The dry fields during fall and spring, and partially flooded fields during the winter provide for some insect prey. None of the species rely on waste grain (except for the insect populations the grain may support) and thus absence of waste grain is not a concern for the species as it is for other avian species.

Idling of rice farmland for a season has the potential to reduce some summer and fall forage for egrets and herons that roost within 5 miles of the idling action. Because the birds will travel long distances to forage and because environmental measures for the giant garter snake will provide for the maintenance of aquatic habitat in rice growing areas, the only effect on these species is a potential change in forage patterns from idled fields to fields with abundant prey. Idling of rice farmland will not affect roosting sites; there is less human activity because no farming is occurring. Therefore, effects would be less than significant and no environmental measures are proposed.

The EWA program may affect but is not likely to adversely affect the snowy egret.

4.16.4 Conservation Measures

Conservation measures are not proposed for the snowy egret because this species is not likely to be adversely affected.

4.16.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The snowy egret has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.16.3.

4.17 Tricolored Blackbird (*Agelaius tricolor*)

4.17.1 Status in the Action Area

The tricolored blackbird is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), a BLM Sensitive Species (CDFG 2003), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

Historically, tricolored blackbirds nested throughout much of California west of the Sierra Nevada, in coastal southern California, and in portions of northeastern California.

Flocks and breeding colonies were observed in the Shasta region, Suisun Valley, Solano County; near Stockton, San Diego, Los Angeles, Santa Barbara, Glenn County, Sacramento County, Butte County, Colusa County, Yolo County, and Yuba County (Heermann 1853, Belding 1890, Baird 1870, Neff 1937, Orians 1961, Payne 1969). Figure 3-9 depicts the distribution of tricolored blackbird nesting colonies. Extensive marshes that provided ample breeding habitat for tricolors in the Central Valley from overflowing river systems had been reduced by 50 percent by the mid-1980s (Frayer et al. 1989). Additionally, native perennial grasslands, which are primary foraging habitat, have been reduced by more than 99 percent in the Central Valley and surrounding foothills (Kreissman 1991). For breeding-colony sites, tricolored blackbirds require open accessible water, a protected nesting substrate that is usually flooded or has thorny or spiny vegetation, and a foraging area that provides adequate insect prey within a few kilometers of the nesting colony (Beedy 1989, Hamilton et al. 1995). In addition to consuming insects, the tricolored blackbird also eats seeds and cultivated grains, such as rice and oats. It will often forage in croplands, pastures, grassy fields, flooded land, and along edges of ponds (Zeiner et al. 1990).

Tricolored blackbirds leave wintering areas in the Sacramento-San Joaquin Delta and along coastal central California in late March and early April. Its breeding season is from mid-April to late July. Breeding colonies will return to the same area year after year if the site continues to provide adequate nesting sites, water, and suitable foraging habitat (Dehaven et al. 1975).

4.17.2 Effect Assessment Methods

The only habitat used by the tricolored blackbird affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the blackbird. Table 4-23 provides the relationship of the tricolored blackbird with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near nesting areas when rice crops are idled.

4.17.3 Project Effects

Tricolored Blackbird Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing summer forage and breeding colonies for this Covered Species. The tricolored blackbird is an inhabitant of the Sacramento-San Joaquin Delta and central coast of California in the winter and typically migrates to breeding locations near open freshwater in Sacramento County and throughout the San Joaquin Valley in the spring (Dehaven et al. 1975). In addition to insects and seeds, the tricolored blackbird forages on cultivated grains such as rice on croplands and flooded fields, and waste grain rice following the harvest (Zeiner et al. 1990). One study showed that rice constituted up to 38 percent of the annual diet of tricolored blackbirds (Crase and DeHaven 1978), but most reports indicate that insects can make up to 90 percent of their diets in the summer shifting to 88 percent vegetative matter in the winter.

Tricolored blackbirds generally breed from March to July, but have been observed breeding in the Sacramento Valley in October and December. In some years there may be up to three attempts at breeding, particularly if a colony is disturbed during an earlier attempt. Although the primary cause for the overall decline in tricolored blackbird populations is due to loss of wetland habitat to agriculture and urban development, the current threat to the population is predation by mammalian and avian predators and the destruction/disturbance of breeding colonies. Tricolored blackbirds can breed in large colonies, with over 100,000 birds being reported for some colonies.

Tricolored blackbirds have three basic requirements for selecting breeding colony sites (Beedy and Hamilton, 1997): 1) open accessible water; 2) protected nesting substrate, usually either flooded or thorny or spiny vegetation; and 3) suitable foraging space providing adequate insect prey within a few kilometers of the nesting colony. Rice fields can provide two of the three requirements (water and insects), but the adjacent vegetation is usually not sufficiently shrubby and the emergent rice plants are not tall and strong enough to support nests, at least during the time when initial nesting is being attempted. Colonies have been rarely observed in rice fields (USFWS 1999), but can use emergent vegetation in canals associated with rice fields. The rice agriculture cycle provides insect forage in the flooded fields during the summer and waste grain forage over winter.

Tricolored black birds do not necessarily return to the same location each year to breed and can vary location between season or within a season. Because the birds have specific breeding habitat requirements and there are limited areas available for breeding, colonies are typically found in the general vicinity of the previous years colony, if the same site is not being used.

The primary concern for the tricolored blackbird's association with rice fields is the use of the habitat as a source of insects and waste grain forage. The birds are highly mobile and fly up to 3 miles from the colony site to forage. During the winter, the birds are more nomadic and move from pastureland and dairy farms to feed, primarily on vegetative matter. The idling of rice fields could affect the behavior of the birds related to foraging distribution patterns. Because environmental measures for the giant garter snake will prevent large blocks of land from being fallowed and will require maintenance of ditch habitat, any effect on foraging behavior is considered less than significant for the tricolored blackbird.

Therefore, EWA actions may affect but are not likely to adversely affect the tricolored blackbird.

4.17.4 Conservation Measures

Conservation measures are not proposed for the tricolored blackbird because this species is not likely to be adversely affected.

4.17.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The tricolored blackbird has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.17.3.

4.18 White-faced Ibis (*Plegadis chihi*)

4.18.1 Status in the Action Area

The white-faced ibis is designated as a species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

In California the white-faced ibis was once common but, even by the 1940s, the white-faced ibis' population was declining (Grinnell and Miller 1944). By the 1970s, there were virtually no breeding white-faced ibises in California (Remsen 1978). In the 1980s, after decades of decline, the population of this species began to rebound. Figure 3-8 depicts the distribution of white-faced ibis rookeries. Key areas of wintering white-faced ibis in the Central Valley (1990-1996) include the Delevan-Colusa Butte Sink area, northwestern Yuba County (District 10), the Yolo Bypass, Grasslands Complex, and Mendota Wildlife Area (Shuford and Hickey 1996).

The white-faced ibis requires freshwater marshes and other wetlands for nesting sites and for wintering foraging grounds. The ibis forages in shallow waters, including seasonal wetlands and rice fields, or on muddy banks where it probes for invertebrates, small fish, and amphibians (Zeiner et al. 1990).

4.18.2 Effect Assessment Methods

The only habitat used by the white-faced ibis affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the ibis. Table 4-23 provides the relationship of the white-faced ibis with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.18.3 Project Effects

White-faced Ibis Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing winter forage for this Covered Species. The white-faced ibis is primarily a winter migrant to the Central Valley. The largest breeding colonies are in Utah, Nevada, and Oregon. Key areas for wintering include the Delevan-Colusa Butte Sink, northwestern Yuba County, the Yolo Bypass, Grasslands Wetlands Complex, and Mendota Wildlife Area. There are reports of breeding colonies in the Central Valley, particularly within the Mendota Wildlife Area and Colusa National Wildlife Area. Within the Central Valley, the species occupies a variety of aquatic and wetland habitats, including rice fields that provide abundant prey (Remsen 1978). The ibis can breed from April to September (USFWS 1999).

Primary cause for the decline in numbers of this species is the drainage of wetlands and destruction of nesting habitat. SFA habitat is one of the many habitat types used by the species, and the species has no particularly affinity to rice fields compared to other wetland habitats.

The diet of the ibis consists of insects, small fish, and miscellaneous invertebrates (Granholm 1991). It feeds in flooded (less than 20 cm water depth) (USFWS 1999; RMI, 1997) or inactive fields that contain its prey items. Surveys of the Sacramento Valley found 66 percent of the ibis concentrated in agricultural fields. In one study up to 53 percent of the foraging ibis were observed in rice stubble (Shuford et. al. 1996).

The white-faced ibis is well adapted to changes in environmental conditions such as drought and flooding; therefore, use of specific areas can vary greatly from year to year depending on habitat conditions (Granholm 1991). The species interaction with the rice crop cycle includes using flooded land in the summer for foraging of prey, and dry or flooded rice fields in the winter, also for prey. Because the species is adaptive and responds to changes in environmental conditions, the effect dude idling of flooded rice fields is considered to be less than significant. No environmental measure is proposed for the species.

Therefore, EWA actions may affect but are not likely to adversely affect the white-faced ibis.

4.18.4 Conservation Measures

Conservation measures are not proposed for the white-faced ibis because this species is not likely to be adversely affected.

4.18.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The white-faced ibis has been designated an “m” or “maintain” species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.18.3.

4.19 Giant Garter Snake (*Thamnophis gigas*)

4.19.1 Status in the Action Area

The giant garter snake is listed as a threatened species under both the federal Endangered Species Act and the California Endangered Species Act (CALFED 2000).

The giant garter snake historically ranged throughout the Central Valley, but is currently extirpated from the southern 1/3 of its historic habitat. Figure 3-10 depicts the current distribution of giant garter snake population areas in the 6 counties that are identified for potential rice idling actions. During the winter (the snake's dormant season) and at night it typically inhabits upland, small mammal burrows and other soil crevices. Daytime and active season (early spring through mid-fall) habitats include aquatic sites, emergent vegetation, and grassy banks along agricultural wetlands, irrigation and drainage canals, sloughs, ponds, small lakes, and low gradient streams. The GGS feeds on fish, amphibians, and amphibian larvae. The decline of the GGS is attributable to habitat loss through flood control and agricultural activities. The final rule listing the giant garter snake as threatened determined that designating critical habitat was not prudent.

4.19.2 Effect Assessment Methods

The effect assessment methods described for Seasonally Flooded Agriculture in Section 6.15 are used here to assess effects on the Giant Garter Snake. Table 4-23 provides the relationship of the giant garter snake with rice lands and the rice production cycle. In addition, to the conservation measures described in Section 6.15.4, the maximum amount of crop idling that would take place annually would not be more than 20% of the rice acreage in any given county or any individual district. USFWS will prepare a programmatic biological opinion on the effects on the giant garter snake of EWA water acquisitions that include rice idling. The programmatic biological opinion will outline expected conservation measures and a streamlined process for review of proposals to idle rice or shift rice to other crops. Proposals to idle rice fields or shift rice to other crops each year would be subject to formal ESA Section 7 consultation with the USFWS to determine effects to the giant garter snake. This formal consultation would begin when the EWA agencies submit a package from a willing seller describing the location of the rice fields proposed for idling and which giant garter snake conservation measures would be followed, and request that the proposal be appended to the programmatic biological opinion. This package will include maps and a legal description of the fields. The USFWS will then review the proposals and append it to the programmatic consultation if the conservation measures and effects of the action are consistent with the programmatic biological opinion. If the USFWS determines that the proposal is not consistent with the programmatic, or additional effects not previously analyzed may occur, then additional compensatory giant garter snake mitigation may be required, consistent with the REA and the giant garter snake Recovery Plan. Further section 7 consultation may be required if additional effects not considered in the programmatic consultation are identified. Compensatory mitigation for certain crop idling actions might include the acquisition, restoration, and preservation of additional giant garter snake habitat. Prior to submittal of a final package, EWA agencies may consult informally under ESA section 7 to get a preliminary effects determination and further refine project descriptions and proposed conservation measures.

4.19.3 Project Effects

Giant Garter Snake Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing replacement wetland habitat that this Covered Species uses year *around thereby jeopardizing population numbers.* Giant garter snakes' reliance on rice fields and agricultural drainage is due to a lack of viable alternative habitats. Most of its historic wetland habitat has been lost (USFWS 1999). Riparian woodlands do not provide the basking areas the snake requires to warm to activity levels (Hansen and Brode 1980), nor do they provide the pools of concentrated prey such as carp, mosquitofish, and bullfrogs (Rossman et al. 1996) the species relies upon for food. Open river environments make the giant garter snake susceptible to predation by non-native species such as bass and leveed rivers do not provide the snake with grassy banks for basking or elevated areas for hibernation (58 FR 54053, Oct 20, 1993).

Rice fields provide all necessary elements of the giant garter snake habitat. This includes irrigation canals and flooded fields that provide forage and escape, emergent vegetation for cover, and upland areas along canals for basking and dens. Populations of giant garter snakes in the Colusa, Butte, Sutter, and American River Basins are mostly associated with rice field habitats and their connecting irrigation and drainage canals (58 FR 54053, October 20, 1993). Current studies are finding up to 50 percent of observed individuals in rice field habitats (USFWS 1999).

The rice agriculture cycle, as described in Section 10.1.1.14, coincides closely with the habitat requirements of the giant garter snake. The snake hibernates over winter in dens near the fields and thus land management practices that do not involve reconstruction of drainage channels will not affect the snake. (The Rice Council has provided guidance to rice growers in relation to protecting the snake.) When the snake emerges from its burrow in March and April, water is only in the drainage ditches. This helps concentrate prey and facilitates the mating process. After field preparation, the fields are flooded increasing the forage habitat for the snake. When flooded, rice field habitat provides warm shallow open waters of prey for foraging (Hansen 1980, Brode and Hansen 1992, Hansen and Brode 1993). Once the rice plant emerges, the rice field provides cover from predators.

In July to early September, the female snakes give birth. Rice fields continue to provide food and cover for the snake population. Finally, in the fall when the fields are drained, the snake's prey species are concentrated in the drainage ditches. The snakes move into the adjacent drainages that, as long as the vegetation cover is retained, provide the necessary habitat and forage to prepare the snake for hibernation. The concentration of prey in the canals is a benefit to the snakes inhabiting rice farmland. In the fall, the snakes return to burrows and cracks in the upland area to hibernate. Snakes are generally dormant from November to February (USFWS 1999).

In September, juveniles make extensive use of the pools of concentrated prey that are associated with the temporally coinciding rice field drainage areas. Prey concentrations in drainage pools provide pre-dormancy gorging opportunities for giant garter snakes.

Predation of giant garter snakes is limited to the habitat corridors such as irrigation and drainage ditches. Irrigation ditches provide both mobility and extensive cover for the snake (USFWS 1999). Removal of vegetation can expose snakes to predators, thereby considerably diminishing this particular habitat benefit. The loss of a food source and critical habitat as a result of EWA crop idling actions would have a significant adverse effect on the giant garter snake populations associated with SFA habitat.

Crop idling actions may affect but are not likely to adversely affect giant garter snake populations with implementation of the following conservation measures.

4.19.4 Conservation Measures

Within the Sacramento River valley, the giant garter snake (GGS) is highly dependent on rice fields and associated irrigation ditches. EWA actions, or cumulatively, water acquisitions, could idle up to 20 percent of flooded rice fields in each county. The following text provides the proposed approach and conservation measures to protect the GGS.

As part of the EWA consultation, the USFWS will give programmatic approval to crop idling, followed by a site-specific consultation process to ensure consistency with the programmatic approval. The programmatic consultation will include three main elements: 1) the process by which site-specific agreements will be attained; 2) the list of conservation measures (avoidance, minimization, and conservation measures) which would be used wholly or in part to minimize effects of water transfers involving fallowing or crop-shifting; and 3) a description of GGS conservation strategy in Chapter 4 of this ASIP.

USFWS EWA consultation with the Project Agencies will outline a year-by-year "site specific" process to address crop idling impacts to GGS and will put boundaries on upper limit on the amount of crop idling that may occur in any given year, considering the existing 20 percent limit. Additional measures to those presented in this EIS/EIR may be incorporated as a part of consultation based on site-specific conditions.

Each year, once it has been determined that crop idling will occur, the EWA Project Agencies will contact USFWS staff to begin informal consultation and will put together a package describing where the idling activities will take place and what proposed minimization measures will be followed. This package will include maps of the proposed idled fields. USFWS will work with the EWA Project Agencies to determine if minimization measures proposed are sufficient and if additional compensatory habitat is required.

The EWA agencies will ensure through contract terms or other requirements that the following conservation measures will be implemented:

- The EWA agencies will ensure parcels from which water is to be acquired are outside of mapped proscribed areas (see ASIP Figure 3-11), which include:
  - *Refuges* – Land adjacent and within 1 mile of Sacramento, Delevan, Colusa, Sutter, and Butte Sink National Wildlife Refuge (NWR), and the Llano Seco Unit of the Sacramento River NWR, Gray Lodge Wildlife Area (WA), Upper Butte Basin WA, Yolo Bypass WA, and Gilsizer Slough CE;

   - *Corridors Between Refuges* – Lands adjacent to Hunters and Logan Creeks between Sacramento River NWR and Delevan NWR; Colusa Basin Drainange Canal between Delevan NWR and Colusa NWR; Little Butte Creek between Llano Seco units of Sacramento River NWR and Upper Butte Basin WA, and Howards Slough Unit of the Upper Butte Basin WA, Butte Creek Upper Butte Basin WA, and Gray Lodge WA;

   - *Waterways Serving as Corridors* – Land adjacent to Butte Creek, Colusa Basin Drainage Canal, Gilsizer Slough, land side toe drain along east side of the Sutter Bypass, Willow Slough and Willow Slough Bypass in Yolo County, North Drainage Canal and East Drainage Canal in Natomas Basin

   - *Other Core Areas* – East of SR99 and between Sutter-Sacramento County line and Elverta Road in Natomas Basin, Yolo County east of Highway 113;

- The water seller will ensure that water is maintained in irrigation and drainage canals to provide movement corridors;

- The water agency will ensure that the block size of idled rice parcels will be limited to 160 acres (includes rice fields shifting to another crop);

- The water agency will ensure that mowing along irrigation and drainage canals will be minimized and mowers will be elevated to at least 6 inches above the ground level;

- The water agency will ensure that, if canal maintenance such as dredging is required, vegetation will be maintained on at least one side; and

- The EWA agencies will maximize geographic dispersal of idled lands.

GGS conservation measures <u>may</u> include the following, as appropriate:

- The EWA agencies will avoid purchasing water from the same field for more than two consecutive years;

- The EWA agencies will recommend that sellers replace culverts already planned for repair or replacement with oversized culverts to facilitate better wildlife dispersal;

- The EWA agencies will recommend that sellers replace water control structures with those requiring less maintenance and less frequent replacement in order to minimize maintenance impacts (steel or wooden control boxes with pre-poured concrete boxes); and

- The water agencies may fund research or surveys.

4.19.5 Contribution to Recovery

The giant garter snake is designated an "r" species in the Ecosystem Restoration Program ("ERP") Plan and Multi-species Conservation Strategy ("MSCS"). This means that CALFED will make specific contributions toward the recovery of the species by undertaking some of the actions under its control and within its scope that are necessary to recover the species. The Stage 1 expectation for the giant garter snake is described in the ERP Volume 1:

> *Stage 1 Expectation for the Giant Garter Snake*
> *Existing natural habitats that have available water all year will have been maintained, and key habitats in agricultural area identified for special management. Sites for freshwater marsh restoration will have been identified and a restoration program established.*

The ERP includes targets and programmatic actions (specific implementation measures) to maintain, enhance or restore aquatic, wetland, riparian, and upland habitats in the ERP Focus Area in order to help in the recovery of the giant garter snake by increasing habitat quality and area. The ERP also includes conservation measures that provide additional detail to ERP actions that would help achieve giant garter snake habitat or population targets and improve our scientific understanding of the species. The USFWS also has a draft recovery plan for the giant garter snake, which is in the last phase of the approval process that will culminate in the release of the final recovery plan.

CALFED has made commitments to conduct essential studies to fill gaps in our scientific knowledge about the giant garter snake's ecological requirements and to conduct surveys to provide the information needed to ensure that recovery objectives for the species are achieved. The ROD identifies certain MSCS-ERP milestones that need to be achieved during Stage 1 of CALFED Program implementation that consist, in part, of ERP targets, actions, and science objectives that will provide conservation benefits for the giant garter snake. These milestones were developed to ensure that best –available scientific information would be developed by CALFED and used to guide restoration and recovery strategies for the giant garter snake using the adaptive management process described in the ERP Strategic Plan for Ecosystem Restoration. The MSCS-ERP milestones were also developed to ensure that the ERP would be implemented in a manner and to an extent sufficient to sustain programmatic FESA, CESA, and NCCPA compliance for all CALFED Program elements. The ERP implementation priorities, strategies, actions and milestones for Stage 1 that will provide conservation benefits for the giant garter snake include:

- Protection, enhancement and restoration of habitat that will include mosaics of seasonal wetlands, fresh emergent wetlands, riparian habitat, and adjacent uplands;
- Management of suitable habitat areas adjacent to known populations to encourage the natural expansion of the species;
- Development of wildlife friendly agricultural programs and practices;
- Improvements to agricultural infrastructure (e.g. ditches, drains and canals) to improve habitat values associated with agricultural lands and to reduce stressors to giant garter snake populations;

- Development and implementation of a monitoring and assessment program;
- Range wide surveys for the giant garter snake.

Implementation of the ERP giant garter snake strategy described in this section is essential to the successful implementation of the EWA program. The MSCS describes CALFED's intention to link CALFED actions for purposes of implementation, as part of the ASIP process. If actions are linked in this manner USFWS, NMFS, and DFG can review the actions and their effects on the covered species and make their determinations under FESA, CESA, and NCCPA for the linked actions based on their overall beneficial and detrimental impacts to the covered species, rather than assessing the impacts of each action individually. This approach allows implementing entities to further simplify the compliance process for CALFED actions that are compatible or complementary from a biological standpoint. **This is not to say that the ERP actions will be used to avoid, minimize, and compensate for any adverse effects of the EWA program—each CALFED action, including the EWA program, must avoid, minimize, and compensate for its adverse environmental effects.** However, in determining whether the EWA program will jeopardize the continued existence or modify critical habitat of any listed species, USFWS, NMFS, and DFG can consider together the beneficial effects of the ERP strategy for the giant garter snake and the potential adverse effects on fish and wildlife of the EWA program with its conservation measures. DFG would also consider the combined effects of the ERP giant garter snake strategy and the EWA program when it determines whether the linked actions together provide adequately for the conservation and management of State-covered species.

The following section describes the key program objectives that will guide the development of a giant garter snake conservation strategy that will build upon the foundation of the USFWS Recovery Plan for the Giant Garter Snake; Ecosystem Restoration Program Plan; the Draft Stage 1 Implementation Plan; and MSCS-ERP milestones for the species. The conservation strategy will identify specific research objectives including population surveys and experimental analyses of population responses to varying cropping patterns. It will include the identification of priority areas for habitat protection, enhancement and restoration, consistent with the Stage 1 expectations for the species. The strategy will also include "wildlife friendly" agricultural and water management practices to reduce giant garter snake population stressors. From this strategy, proposals will be developed and will conform to all of the standards established by CALFED for the proposal review and selection process. Implementation of this strategy will begin with the submission of proposals to implement the highest priority actions at the earliest possible opportunity. An outline of the giant garter snake conservation strategy is provided in Section 4.19.6 below.

The programmatic consultation process for the giant garter snake, as described in Section 4.19.2 above, will require the USFWS and DFG to review "site-specific" rice idling proposals and evaluate whether implementation of a proposed action, in conjunction with conservation measures described in Section 4.19.4, will continue to provide the required level of protection to the species. The USFWS and DFG, which are both EWA and ERP Implementing Agencies, will also assess rice idling proposals within the context of progress being made toward implementing the giant garter snake conservation strategy and under certain circumstances may require additional conservation measures.

4.19.6 Conservation Strategy for the Giant Garter Snake

Recovery strategy

The recovery strategy outlined in the Draft Giant Garter Snake Recovery Plan includes: 1) habitat protection and restoration; 2) research to refine recovery goals (species distribution and status, reserve design, genetics, life history, use of corridors, effects of contaminants, and population and management response monitoring); and 3) actions to reduce or eliminate threats (stressors), including developing management practices for agricultural and water management operations.

Science objectives

Specific research objectives include conducting inventory and surveys, developing additional techniques to expand research capabilities, investigating optimal habitat and reserve design, and examining effects of cropping patterns and agricultural practices on the giant garter snake. Other research objectives that may be met as part of these studies include gathering life history data necessary to conduct population viability analyses and archiving tissue for genetic and contaminants analyses.

Inventory and surveys: No systematic range-wide surveys have been conducted for the giant garter snake and data for many populations is 10-15 years old (if not older). Inventory and survey needs include: mapping to identify suitable habitats; determining the species status, particularly in the Delta and the San Joaquin Valley; and defining the species distribution in rice-growing areas east of the Feather River and in western Placer County.

Development of new research techniques: Giant garter snakes are difficult to study because of their wariness, cryptic coloration, and inaccessibility of their wetland habitats. Techniques for trapping in uplands and within wetlands interiors (as opposed to wetland margins) are needed to better examine habitat use by the giant garter snake. Techniques for use of external radios that can be used on smaller individuals are also needed to examine effects of management activities on a broader range of size/age classes.

Habitat and reserve design: Although basic habitat components are known, optimal habitat conditions necessary to support viable populations of giant garter snakes have not been defined. Monitoring giant garter snake response to restoration efforts, and examining the effects of varying habitat restoration designs are needed to further define optimal habitat conditions that should be incorporated into restoration plans and management plans.

Effects of cropping patterns on the giant garter snake: The draft recovery plan recommends maintaining rice agriculture to contribute to recovery, but no model exists for optimal conditions to maintain giant garter snake populations in a rice landscape. Evaluating the response of giant garter snakes to varying cropping patterns that may occur as a part of normal agricultural practices will be essential to developing strategies to protect agricultural lands consistent with the needs of the giant garter snake.

Habitat protection, enhancement and restoration objectives

Priority areas for habitat protection and restoration in the Sacramento Valley include areas within the rice growing regions of the Colusa, Butte, Sutter, and American basins that currently lack native or restored wetland habitats. These areas include the southern portion of the Colusa Basin, the Butte Basin east of Butte Creek, the Sutter Basin, and the American Basin north of the Natomas Cross Canal. Habitat protection and restoration in these priority areas will provide core habitat areas to buffer giant garter snakes from the effects of market- or drought-driven fluctuations in rice production. We expect models for habitat restoration and cropping patterns to be tested and adaptively managed as part of habitat protection and restoration in these areas.

Reduction of stressors

A main component of giant garter snake recovery is threat (stressor) reduction. This includes developing management practices for agricultural and water management operations that: (1) minimize risk of injury to giant garter snakes; (2) minimize habitat disturbance; and (3) allow establishment and/or maintenance of habitat for the giant garter snake. An additional component of stressor reduction includes improvements to agricultural and water management structures that improve giant garter snake and wildlife passage and reduce maintenance needs.

Research on other threats that affect giant garter snakes within otherwise suitable habitat, such as non-native predators, contaminants and pesticide/herbicide use, and parasitism, are also expected to further define management actions necessary to remove or ameliorate threats (stressors) and maintain giant garter snake populations.

Implementation

Steps in implementation of the ERP giant garter snake strategy will include: 1) selecting sites for monitoring and adaptive management of restoration designs and agricultural treatments, and developing habitat mapping to identify sites for survey efforts; 2) establishing baseline conditions of sites, designing restorations and/or agricultural treatments, and beginning distributional and status surveys based on habitat mapping results; 3) build restoration and implement agricultural treatments and start monitoring efforts, and continue surveys; and 4) continue monitoring giant garter snake responses and habitat conditions.

4.20 Western Pond Turtle (*Clemmys marmorata*)

4.20.1 Status in the Action Area

The western pond turtle is designated as a California species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). It is identified by CALFED as a species of concern.

The western pond turtle is common to uncommon throughout California, west of the Sierra-Cascade crest. Figure 3-11 depicts the distribution of western pond turtles. Today the western pond turtle remains in 90 percent of its historic range, but at greatly reduced numbers (USFWS 1999). It inhabits aquatic areas with plentiful hiding and basking sites. A permanent water source is necessary to avoid desiccation, especially for hatchlings. Underwater bottom mud or upland habitat is used for hibernation in colder areas. Upland habitat is used for aestivation and reproduction. The turtle seeks aquatic plant material, beetles, aquatic invertebrates, fishes, and frogs for a food source. Loss of upland nesting habitat through human disturbance is a potential source for the turtles' decline.

4.20.2 Effect Assessment Methods

The only habitat used by the western pond turtle affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the turtle. Table 4-23 provides the relationship of the western pond turtle with rice lands and the rice production cycle. The primary concern is the loss of habitat by drying up irrigation and drainage canals.

4.20.3 Project Effects

Western Pond Turtle Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing habitat for this Covered Species. The western pond turtle is the only native box turtle widely distributed in the western United States. Historically, the turtle once inhabited the vast permanent and seasonal wetlands of the Central Valley. The draining of wetlands for agriculture and urban development has greatly reduced this species' habitat. The western pond turtle is found in brackish permanent to intermittent aquatic habitats, including marshes, rivers, ponds, streams, and vernal pools. In the Central Valley it is also found in man-made habitats such as irrigation ditches, reservoirs, and ponds. Its preferred habitat is slow moving or quiet water, with emergent vegetation and undercuts for refuge. Protected, grassy uplands with a clay/silt soil are the preferred nesting sites. Because irrigation ditches typically are maintained, they generally do not include all required habitat elements for the turtle, particularly nesting habitat.

In addition to the loss of aquatic habitat, other causes of population decline include increased predation and collecting by man. Poor reproductive success due to predation and nest destruction is also hampering the turtle's recovery.

Females move upland from aquatic habitat to lay from 1 to 13 eggs. Eggs are laid May through July and juveniles hatch during August to October. Juveniles generally stay at the next site over winter. Movement of females from aquatic habitat to the nest and back, and juveniles from the nest, exposes the turtles to predation, particularly in agricultural areas where vegetation cover is controlled.

The diet of the western pond turtle is comprised primarily of small invertebrates, but adults do consume some vegetative matter. In seasonally flooded agricultural habitat, irrigation ditches and flooded rice land can contain required habitat elements for box turtles. The turtles can forage in the aquatic habitat and bask on adjacent levees. The turtles are active during the spring, summer, and fall when rice preparation, growing, and harvesting is performed, respectively.

Because the western pond turtle can utilize irrigation ditches and rice fields as habitat, any action that dries up the habitat and forces the turtle to migrate to new areas, also exposes the turtle to increased predation. Further reduction of turtle population would be considered significant if it resulted from idling of seasonally flooded agricultural land.

Crop idling actions may affect but are not likely to adversely affect western pond turtle populations with implementation of the following conservation measure.

4.20.4 Conservation Measures

Ditches and drains associated with rice fields provide suitable habitat for the western pond turtle. The following conservation measures would ensure effects of crop idling actions on western pond turtle habitat are avoided or minimized.

- The willing seller will be required to maintain water levels in irrigation and drainage canals to within 6 inches of non-program conditions and do not completely dry out canals.

4.20.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The western pond turtle has been designated an “m” or “maintain” species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.20.3.